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Final Environmental Impact Statement
Integrated Pest Management

Provolt Seed Orchard
Grants Pass (Jackson & Josephine Counties), OR

Charles A. Sprague Seed Orchard
Merlin (Josephine County), OR

BLM
MEDFORD DISTRICT OFFICE
JUNE 2005

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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Photographs on Cover:

Provolt: Douglas-fir production Orchard Unit 2 - Butte Falls 3 Unit. Riparian area along Applegate River in background.

Provolt: Young developing Douglas-fir cones in April

Provolt: Orchard Unit 3 in foreground; office and administrative buildings; State Hwy. 238; OUs 4, 6, 8, 10, 12, 14

Sprague: Sugar pine production Orchard Unit 53 - developing conelets covered with cloth bags for insect protection and seed collection

Sprague: Lake CASSO

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Medford District Office
3040 Biddle Road
Medford, Oregon 97504

IN REPLY REFER TO:

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Dear Reader:

Attached is the final environmental impact statement (EIS) for a proposed integrated pest management (IPM) program at BLM's Provolt Seed Orchard, located near Grants Pass, Oregon, in Josephine and Jackson Counties, and the Sprague Seed Orchard, located near Merlin in Josephine County. The proposed IPM program will manage the insect, weed, animal, and disease problems at Provolt and Sprague, and maintain healthy, vigorous crop trees and other plants for the production of seed and other vegetative materials, which are used primarily for reforestation and a variety of land management activities. This EIS analyzes the potential impacts of the proposed action and alternatives, and will be used in the development of the IPM program at Provolt and Sprague.

The *National Environmental Policy Act* requires BLM to assess the potential environmental impacts of the proposed action and alternatives, and to involve the public in its decision-making process. In accordance with Executive Order 12372, *Intergovernmental Review of Federal Programs*, BLM requested input from other Federal, state, and local agencies and from the public on the Draft EIS, which was published in June 2003, as announced in the *Federal Register* [68(124):38324] on June 27, 2003. BLM received four comment letters on the Draft EIS, which are addressed in this Final EIS. One comment was provided during the public meetings held at the seed orchards on July 14 and 15, 2003.

The Environmental Protection Agency (EPA) will publish a notice of the availability of the Final EIS in the *Federal Register*. Following the 30-day availability period that begins with publication of EPA's *Federal Register* notice, BLM will issue a Record of Decision (ROD) announcing selection of the alternative to be implemented. Any comments you wish to submit during this 30-day availability period should be mailed, faxed, or e-mailed directly to:

Mr. Grodon LyFord, Manager
Provolt and Sprague Seed Orchards
3040 Biddle Road
Medford, OR 97504
Fax: (541) 618-2400
E-mail: Medford_SPOEIS_Mail@or.blm.gov

This forest management decision may be protested under 43 CFR 5003 - Administrative Remedies. In accordance with 43 CFR 5003.2, the decision for this project will not be subject to protest until the notice of availability of the ROD is first published in the *Federal Register* by EPA, approximately 30 days after the notice of availability of this Final EIS. Protests of the decision must be filed with this office within 15 days after newspaper pubication of the notice of availability of the ROD. If no protest is received by the close of business (4:15 p.m. Pacific Standard Time) on the 15th day, the decision will become final. If a timely protest is received, the decision will be reconsidered in light of the protest and other pertinent information available in accordance with 43 CFR 5003.3.

Sincerely,

Timothy B. Reuwsaat,
District Manager, Medford District

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Final Environmental Impact Statement
Integrated Pest Management Program, BLM Provolt Seed Orchard
Grants Pass, Josephine and Jackson Counties, Oregon
and
BLM Sprague Seed Orchard
Merlin, Josephine County, Oregon

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Designation: Final Environmental Impact Statement (EIS)

Privacy Advisory

Any comments on this Final EIS are requested by 30 days after the notice of availability is published. In accordance with the Privacy Act, individuals (but not organizations and businesses) may request their name be withheld from public review by stating this request at the beginning of their letter.

Abstract

The Bureau of Land Management (BLM) is proposing to implement an integrated pest management (IPM) program at Provolt and Sprague Seed Orchards. In compliance with the *National Environmental Policy Act* (NEPA) of 1969, BLM has prepared this environmental impact statement (EIS), which assesses three action alternatives and the no action alternative:

- **Alternative A—Maximum Production IPM**. Pests would be managed using all identified biological, chemical, prescribed fire, cultural, and other pest control methods.

- **Alternative B—IPM with Environmental Protection Emphasis (Proposed Action).** Pests would be managed using all of the methods in Alternative A, with limitations designed to protect worker health and safety and the environment. The limitations are based on the conclusions of a recent risk assessment, scoping comments, and recommendations from BLM interdisciplinary team members.

- **Alternative C—Non-Pesticide Pest Management.** Pests would be managed using only the non-pesticide biological, prescribed fire, cultural, and other methods listed under Alternative A. No biological or chemical pesticide methods would be permitted.

- **Alternative D—No Action: Continuation of Current Management Approach.** The current management system uses all non-chemical-pesticide pest control practices at the seed orchards, as well as chemical pesticides on a case-by-case basis. All biological, prescribed fire, cultural, and other methods would be used in accordance with current procedures. When a specific need is identified for a chemical pesticide, the action would be reviewed to determine whether it is encompassed by an existing NEPA document, or whether an environmental assessment or EIS is required.

Alternative B, the proposed action, is the preferred alternative of BLM.

Resources analyzed in the EIS include air quality, geology, water, land use, human health and safety, biological resources, noise, cultural resources, and socioeconomics and environmental justice. The EIS also assesses the potential cumulative effects of implementing the IPM program along with other actions occurring concurrently at Provolt and Sprague and in the respective surrounding areas. The recently conducted risk assessment is included in the supporting record and summarized in an appendix.

Changes in Proposed Action from Draft EIS to Final EIS

- Use of the biological insecticide B.t. was removed from Alternative C, which was renamed "Non-Pesticide Pest Management."

- Imidacloprid, as a capsule implant, was added to the list of potential insecticides.

- The terms and conditions specified by NOAA Fisheries during Endangered Species Act consultation have been added to the list of limitations (Section 2.3.3) that are inherent to Alternative B, the proposed action.

- The monitoring plan (Appendix B) has been revised for consistency with the terms and conditions specified by NOAA Fisheries.

Executive Summary

The U.S. Bureau of Land Management (BLM) proposes to implement an integrated pest management (IPM) program at the Provolt Seed Orchard in Josephine and Jackson Counties, Oregon, and the Sprague Seed Orchard in Josephine County, Oregon. Both orchards are within BLM's Medford District. In accordance with the *National Environmental Policy Act* (NEPA) of 1969, as amended, which requires Federal agencies to consider environmental consequences in their decision-making process, this environmental impact statement (EIS) identifies potential environmental impacts from each alternative considered. This EIS must be prepared before BLM makes final decisions regarding the selection of an alternative, and be available to inform decision makers and the public of potential environmental consequences of the proposed action or an alternative. Distribution and review of the Draft EIS in June 2003 allowed for public consideration and input concerning the proposed IPM program. After carefully considering comments on the Draft EIS, BLM has made minor changes to the document and is now issuing this Final EIS. After a 30-day availability period for the Final EIS, BLM will publicly state which action will be implemented in a formal document called a Record of Decision (ROD). Subsequent IPM activities will be implemented over the life of the IPM plan (usually 15 to 20 years) in accordance with that decision.

BLM will use the analyses presented in this EIS to decide how to continue operations at the Provolt and Sprague Seed Orchards in a manner consistent with human health and safety considerations and existing environmental protection laws, while maintaining adequate seed and seedling production. Maintaining adequate production includes the implementation of an IPM approach to manage vegetation, insects, disease, and animal pests at the seed orchard. The ROD to be issued on the basis of this EIS, by the BLM Medford District Manager, will identify the specific control methods available for use at Provolt and Sprague for controlling insects, disease, vegetation, and animal pests. No further NEPA documentation relating to IPM should be required before pest management projects are undertaken, unless the seed orchard manager proposes a new IPM product or technology that was not analyzed in this EIS.

Purpose and Need for Action

The purpose of the action is to manage competing and unwanted vegetation, diseases, insects, and other animals at the Provolt and Sprague Seed Orchards. Management of adverse impacts from pests is necessary to allow the seed orchard to produce improved seed for conifer seedling production, preserve valuable individual conifer trees, and produce native species plants (including grass, forb and brush, and other) and seed. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects.

For many years, Provolt and Sprague have managed pests with very limited use of chemicals: glyphosate was used at Provolt in 2001 through 2004 to spot-treat noxious weeds; and at Sprague, glyphosate was used from 1999 through 2003 to spot-treat noxious weeds, and esfenvalerate was used for control of cone and seed insects in two orchard units annually from 1992 to 1996. Their use in the orchards has required preparation of two separate NEPA documents (an environmental assessment, or EA) to analyze the potential impacts from use of these chemicals. Changes and experience with control methods at both orchards have created the need to re-evaluate the pest management program to ensure that the pest management objectives at Provolt and Sprague continue to be met. In addition, the public demand for efficient use of resources in government, as well as for providing appropriate environmental protection, requires

the selection and use of the best pest management techniques for efficient and cost-effective orchard operation over the long term. The pest management objectives at Provolt and Sprague include the following:

- Minimize insect damage to orchard trees, cone crops, and native plants.
- Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
- Reduce growth of vegetation to allow tree establishment and growth and to minimize damage to orchard equipment and infrastructure.
- Treat fungal diseases to maintain the health and vigor of the orchard trees used for seed production, and the health and vigor of the native plant species for seed production.
- Minimize animal damage to orchard trees, native plant (grass and forb) beds (at Sprague), and orchard equipment and infrastructure.

The need for action is also demonstrated by the orchard's experience with periodic problems from insects, disease, weeds, and animals.

Pest Management Methods

There are many methods available to manage vegetation, insects, disease, and animal pests at Provolt and Sprague. These methods generally fall into the following categories: biological, chemical, prescribed fire, cultural, and other methods.

The pest management methods that are analyzed under one or more of the alternatives in this EIS are as follows:

Biological Control Methods

- Insects: bird and bat boxes to attract insect-eating birds and bats, naturally occurring bacteria such as *Bacillus thuringiensis* (a biological insecticide).
- Disease: natural and planted herbaceous vegetation left intact to provide some natural shade to seedlings, thereby reducing stress and potential diseases.
- Animal pests: perch poles for birds of prey; barn owl nest box (Provolt); predators including bobcat, coyote, long-tailed weasel, and fox encouraged to populate the seed orchard lands and aid in control of animal pests.

Chemical Pesticide Methods

- Vegetation: herbicides, including dicamba, glyphosate, hexazinone, picloram, and triclopyr.
- Insects: insecticides, including acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, horticultural oil, imidacloprid, permethrin, propargite, and Safer® soap.
- Disease: a fungicide, chlorothalonil.

The methods that may be used to apply these pesticides at Provolt and Sprague are high-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand, tractor-pulled spray

rig with boom, backpack sprayer, hand-held wick, capsule implantation, and broadcast spreader.

Note that not all chemicals would be used in a given year, and some might never be used. However, their analysis in an alternative in this EIS, and subsequent selection of that alternative in the ROD, would give the seed orchard manager the option of using them in the future should a specific need arise. It is also important to note that each chemical application must first be approved by the Provolt or Sprague seed orchard manager. All pesticides would be applied in compliance with all Federal and Oregon state laws, BLM regulations and policies, and manufacturer recommendations.

Prescribed Fire

- Vegetation: control of unwanted vegetation along fence lines, road sides, and irrigation ditches; pile burning of cut/cleared vegetation.

- Insects: pile burning of insect damaged branches and trees, burning cones from sanitation collections and insect-damaged cones.

- Disease: pile burning of infected branches and trees, burning grass straw in bed rows in the native plant gardens (Sprague).

Cultural Control Methods

- Vegetation: hand-pulling; pruning; thinning; hand tools to cut and grub; tractors with various blade attachments for mowing; gasoline-powered string trimmers; brush cutter machine mounted on tractor; chainsaw for cutting up thinned, rogued, dead/dying orchard trees; power pruner; wood chipper; chipping with large tub grinders and marketing the chips for energy development; mulch mats.

- Insects: pruning, thinning, shaping, use of grafting wax or spray seal on tree wounds, sanitation of damaged branches and trees, sanitation of insect-damaged cones and cones not harvested for seed production, hand-picking large and noticeable insect pupae.

- Disease: pruning, power saws to cut infected or dead trees; removal of diseased plants from the native plant gardens using a tractor and roto tiller (Sprague), mesh shade screens to protect seedlings from heat damage, hand-painting older trees with exposed and thin bark to reflect the sun's rays and insulate from extreme heat.

- Animal pests: walking (herding) stray deer toward and out the gates; pruning tree limbs up at the base of the trees; removing unwanted vegetation, and mowing cover crop vegetation that would provide cover for small mammals; live trapping; lowering the lake's water level for several days to cause beavers to move out (Sprague); pellet gun to reduce western gray squirrel population (Sprague); screening buildings, under buildings, and inside culverts to act as a barrier against western gray squirrel, skunk, and other animals; wire protection of lower tree stems to prevent beaver damage (Provolt).

Other Methods

- Pheromone bait traps to attract and capture damaging insects.

- Fertilization to promote overall tree health, cone production, and disease resistance.

It is the policy of the Department of Interior, and all of its agencies including BLM, to use chemical pesticides only after considering the alternatives; and to develop, support, and adopt IPM strategies wherever practicable.

The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed.

Research into better and more effective control methods is also an essential part of an IPM program. The seed orchard manager would regularly review the pest management methods available for use, including new and developing technologies, to ensure that the seed orchard utilizes the most effective methods of control while minimizing the potential for any adverse environmental or health impacts.

The focus of this EIS is on activities directly relating to implementing an IPM program at the seed orchards. Other routine management actions – such as establishment and maintenance of orchard units, buffer zone management, and facilities/equipment maintenance – are not directly related to IPM and therefore not evaluated in this EIS.

Alternatives

BLM identified and evaluated four alternatives to address the need for a pest management program at Provolt and Sprague, as follows:

- Alternative A: Maximum Production IPM
- Alternative B: IPM with Environmental Protection Emphasis (Proposed Action)
- Alternative C: Non-Pesticide Pest Management
- Alternative D: No Action—Continue Current Management Approach

Alternative B is BLM's preferred alternative. Each alternative is described in more detail below.

Pest management methods that are common to all alternatives are biological methods, cultural methods, prescribed burning, and other non-pesticide control methods. Other activities common to all alternatives include orchard management activities unrelated to pest management and protection measures that would be observed under any alternative. Protection measures are a list of "best management practices" intended to ensure the proper and safe application of pesticides at Provolt and Sprague and include worker protection measures as well as public, environmental, and ecological protection measures.

Alternative A—Maximum Production IPM

Under this alternative, the primary goal is the maximum production of seeds and plants with a very low level of acceptable losses. Provolt's and Sprague's seed orchard manager would have all identified biological, chemical, prescribed fire, cultural, and other pest control methods available for use. An effective IPM strategy for all orchard pests would be implemented under this alternative; however, the primary management objective would be to maximize seed production for annual BLM and cooperator seed needs by aggressively controlling cone and seed insects and other limiting factors. The most effective insect control measures would be implemented, to maximize seed yield and reduce damage to the seed crops with low acceptable seed losses, emphasizing production above other less-effective control methods and considerations, with a low threshold for initiating treatment.

Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under this alternative, the seed orchard manager would have access to the full list of pest management methods identified above; however, chemical use would be restricted by a set of limitations. These limitations address risks predicted by the quantitative risk assessment, respond to scoping concerns, consider the results of previous monitoring, and include recommendations made by the interdisciplinary EIS preparation team. The limitations provide additional protection to human health and the environment, and distinguish the details of potential treatments under Alternative B from those under Alternative A. A complete list of limitations is provided in Section 2.3.3.

Alternative C—Non-Pesticide Pest Management

Alternative C would allow the seed orchard manager to use only the non-pesticide biological, prescribed fire, cultural, and other methods listed above. No biological or chemical pesticides would be permitted.

Alternative D—No Action: Continue Current Management Approach

Alternative D would allow continuation of the current management system, which is the use of all non-pesticide control practices at the seed orchard, as well as the use of pesticides on a specific case-by-case basis. All biological, prescribed fire, cultural, and other non-pesticide methods would be used as needed. When a specific need is identified for a pesticide, the action would be reviewed to determine whether it is encompassed by an existing EA or EIS. This could include applications for controlling cone insects or other orchard insect outbreaks, disease infestations, and any vegetation control necessary that is not covered by other BLM vegetation control NEPA documents.

Alternative Considered But Not Further Analyzed

During the scoping process, one member of the public suggested planting more crop trees than necessary to allow for some loss to pests, which was interpreted as a request to consider no pest management at all. This is not a viable alternative for several reasons. First, this approach could lead to a significant loss of the crop trees in the production units if disease were to occur. Secondly, orchard research has shown that approximately 70% of the seed crop could be lost if no pest management were practiced. To partially offset the effects of cone and seed insects and decreased tree vigor due to disease, it would be necessary to plant production trees in fields that are currently fallow, as the commentor suggested. This solution would require the seed orchard and their cooperators to accept an estimated 10-year reduction in seed production, which is the time that would be required for the newly planted trees to produce collectable seed. This decrease in production could also result in delays in reforestation projects caused by potential seed shortages, or reduced forest growth resulting from the use of genetically inferior seed from other sources. In addition, a more intensive planting regime on seed orchard grounds, with no pest management of any kind, would allow the orchard lands to become a "reservoir" for insects, disease, noxious weeds, and animal pests that would spread to neighboring public and private lands—effectively, becoming a threat and nuisance to the neighbors, particularly those who cultivate crops of their own.

Affected Environment

The Provolt Seed Orchard is located approximately 15 miles southeast of the city of Grants Pass and 25 miles west of Medford, Oregon, near the small community of Provolt and within Josephine and Jackson Counties. It lies within the Applegate River valley of the Klamath Mountains province. The Provolt Seed Orchard is located in the Rogue Basin at the confluence of the Applegate River and Williams Creek on floodplains and an alluvial terrace.

Sprague is located approximately ten miles northwest of Grants Pass and about 40 miles northwest of Medford. The Sprague Seed Orchard is located within the Klamath Mountains, on foot slopes and hills in the Rogue River basin in the Jump-off Joe Creek watershed. Several tributaries to Jump-off Joe Creek flow through the seed orchard.

The orchards' geographical locations between the Pacific Ocean and Cascade Mountains result in a maritime west coast climate, featuring mild, wet winters and warm, dry summers.

The EIS includes a detailed discussion of the relevant environment at the Provolt and Sprague Seed Orchards, providing baseline information to allow the evaluation of potential environmental impacts that could result from the proposed action or an alternative action. The human environment includes natural and physical resources and the relationship of people to those resources.

The resources described in the EIS include, in order of presentation, the physical environment (air, geology, and water), followed by land use, human health, biological resources, and the human environment (noise, cultural resources, socioeconomics, and environmental justice). These resources are described in a sufficient level of detail to adequately support the impact analysis.

Environmental Impacts

Chapter 4 of the EIS details the methods of analysis and assumptions made in evaluating potential impacts to each resource. Approaches included conducting a quantitative human health and ecological (non-target species) risk assessment (summarized in Appendix C), environmental fate and transport modeling, literature review, statistical evaluations, and review of similar actions at other locations. The resource-specific subsections in Chapter 4 describe the methods and present the criteria used for determining whether there are any potential impacts.

The analysis predicted no significant impacts to air quality, geology and soils, land use, noise, cultural resources, and socioeconomics and environmental justice. Human health, biological resources, and surface water (as it relates to aquatic species) are the resources with the greatest potential for impact and should receive the greatest attention in decision-making.

Human Health and Safety

- There are no significant risks to members of the public from the proposed use of any of the control methods under any of the alternatives. However, under Alternatives A, B, and D, an accidental spill of pesticide to a stream could make surface water unsafe for drinking or fishing.

- Under Alternatives A and D, there is a possibility of health effects for workers from some chemical pesticides. No risks of worker health effects were predicted

for pesticide applications under Alternative B. Under Alternatives A, B, and D, an accidental spill onto the skin could cause health risks. Under all of the alternatives, there is a possibility of injury from cultural or prescribed fire methods.

Water Quality

- No significant impacts to groundwater quality were predicted under any alternative.
- Runoff or drift from pesticide or fertilizer applications could enter streams and rivers under Alternatives A, B, and D; and fertilizers could enter surface water in runoff under Alternative C. The effects of the estimated stream concentrations on human health and aquatic species are described under those headings. Under Alternative B, limitations would be in place to control the potential for runoff and drift of pesticides.
- An accidental spill of pesticide concentrate or mix could contaminate groundwater or surface water under Alternatives A, B, and D. A spill of fertilizer could contaminate groundwater or surface water under all alternatives.

Biological Resources

- No adverse impacts to non-target vegetation are expected under any of the alternatives.
- There are possible risks to terrestrial wildlife species from three of the proposed insecticides under Alternatives A and D. Lethality would be expected for non-target insects in an area treated with insecticide under Alternatives A, B, and D. No significant impacts to terrestrial wildlife were predicted under Alternatives B and C.
- There are no significant risks to aquatic species from use of the chemical, biological, prescribed fire, or cultural control methods under any of the alternatives. Under maximum runoff conditions, fertilizer could cause impacts to special status species in the main tributary to Jump-off Joe Creek at Sprague; no aquatic species risks from fertilizers were predicted at Provolt. Under Alternatives A, B, and D, there could be adverse impacts to aquatic species from an accidental spill of pesticide to a stream.

Alternative B is the proposed action, and is BLM's preferred alternative for minimizing long-term impacts to all resources, including human health.

Cumulative Impacts

According to CEQ regulations at 40 CFR 1508.7, "cumulative impact" is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. There are no other major projects proposed in the orchard vicinity that are long-term in nature or would result in significant changes in the physical characteristics of the project area. Another cumulative concern relates to the potential toxic effects of exposure to multiple chemicals. The human health risk assessment addressed cumulative risk to workers and the public from the subset of proposed chemicals that are more likely than others to be used in a given year. No risk was identified for members of the public, but risk was identified for some workers under Alternative A when very conservative assumptions were applied to avoid underestimating the potential impact.

Mitigation Measures

Based on the results of the quantitative risk assessment, the selection of Alternative A, Maximum Production IPM, could result in adverse impacts to human health and

ecological resources. Therefore, CEQ's regulations for implementing NEPA require that potential mitigation measures be identified in this EIS. The identified mitigation measures, described in detail in Section 4.12, restrict rates, frequencies, and other use details for chlorpyrifos, diazinon, dimethoate, dicamba, hexazinone, permethrin, propargite, and fertilizers.

The design of Alternative B, IPM with Environmental Protection Emphasis, includes the limitations specified in Section 2.3.3, and is expected to address all identified potential risks, with the exception of possible maximum scenario risks from fertilizers at Sprague. These risks are only predicted for conditions in which soils are saturated and then a large storm event follows application, which is a situation with a very low probability of occurrence, representing the upper bound of the risk range estimated in the risk assessment. During the ESA consultation process, NOAA Fisheries identified additional terms and conditions to provide additional protection to threatened coho salmon. These requirements are listed in Section 2.3.3 of this Final EIS.

The only significant impacts associated with Alternative C, Non-Pesticide Pest Management, are those from maximum scenario fertilization, as described in the preceding paragraph. No additional mitigation is identified for this risk.

Mitigation measures for use of chemical pesticides under Alternative D, No Action, would be identified on a project-by-project basis during the specific NEPA assessments.

The ROD that will be published at the conclusion of the EIS process will specify the mitigation measures that will be implemented with the selected alternative.

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1.0 Introduction

The U.S. Bureau of Land Management (BLM) proposes to implement an integrated pest management (IPM) program at the Provolt Seed Orchard in Josephine and Jackson Counties, Oregon, and the Sprague Seed Orchard in Josephine County, Oregon. Both orchards are within BLM's Medford District. The *National Environmental Policy Act* (NEPA) of 1969, as amended, requires Federal agencies to consider environmental consequences in their decision-making process. The President's Council on Environmental Quality (CEQ) has issued regulations to implement NEPA that include provisions for both the content and procedural aspects of the required environmental analysis (40 Code of Federal Regulations (CFR) 1500 et seq.). The environmental impact analysis process, as governed by the Department of the Interior's Departmental Manual 516, *NEPA Compliance*, and BLM's Manual H-1790-1, *National Environmental Policy Act Handbook*, is the mechanism by which BLM ensures its decisions are based on an understanding of potential environmental consequences. The CEQ regulations were used in conjunction with the Departmental and Bureau guidance to determine the appropriate level of environmental analysis for this action, which BLM has determined to be an Environmental Impact Statement (EIS).

Preparation of this EIS must precede final decisions regarding the selection of an alternative, and be available to inform decision makers and the public of potential environmental consequences. A Notice of Intent was originally published in the *Federal Register* (FR) on March 26, 1999 (64 FR 14747), and announced BLM's intent to prepare one consolidated EIS for all four Oregon seed orchards. A Revised Notice of Intent was published on March 29, 2001 (66 FR 17192) to announce BLM's revised intent to prepare three separate EISs for the four seed orchards, with each EIS being District-specific and the Medford District EIS including both the Sprague and Provolt Seed Orchards. Distribution and review of the Draft EIS in June 2003 allowed for public consideration and input concerning the proposed IPM program, and provided to decision makers and the public the information required to understand the future environmental consequences of the proposed action or an alternative. After carefully considering comments on the Draft EIS, BLM is now issuing this Final EIS. After a 30-day availability period for the Final EIS, BLM will publicly state which action will be implemented in a formal document called a Record of Decision (ROD). Subsequent IPM activities would be implemented over the life of the IPM plan (usually 15 to 20 years) in accordance with that decision. No further NEPA documentation relating to IPM would be required, unless the seed orchard manager proposes to use a new IPM product or technology that was not included in the alternative selected in the ROD. The NEPA review requirements in this situation are discussed in Section 2.4.4.

This introductory chapter identifies the purpose and need for action, provides a general description of the location of the seed orchards, summarizes scoping comments and issues, and discusses the relationship of this document to other plans, policies, and programs. It concludes by describing the organization of the remainder of this EIS.

1.1 Purpose and Need for Action

1.1.1 Purpose

The purpose of the action is to manage competing and unwanted vegetation, diseases, insects, and animal pests at the Provolt and Sprague Seed Orchards. Management of adverse impacts from pests is necessary to allow the seed orchards to produce improved seed for conifer seedling production, preserve valuable individual conifer trees, and

produce native species plants and seed (including grass, forb, brush, and other). This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects.

For many years, Provolt has managed pests using an IPM program that included a very limited use of chemicals: glyphosate (Rodeo®) was used in 2001 and 2004 to spot-treat noxious weeds. At Sprague, very limited use has also been made of chemicals: glyphosate (Rodeo®) was used from 1999 through 2003 to spot-treat noxious weeds, and esfenvalerate was used for control of cone and seed insects annually from 1992 to 1996 in two orchard units. Both the glyphosate and esfenvalerate uses were addressed in two separate environmental assessments (EAs) (BLM 1992a; BLM 1998). Changes and experience with control methods at the seed orchards have created the need to re-evaluate the pest management program to ensure that the pest management objectives at Provolt and Sprague continue to be met. In addition, the public demand for efficient use of resources in government, as well as for providing appropriate environmental protection, requires the selection and use of the best pest management techniques for efficient and cost-effective orchard operation over the long term. The pest management objectives at Provolt and Sprague include the following:

- Minimize insect damage to orchard trees, cone crops, and native plants.
- Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
- Reduce growth of vegetation to allow tree establishment and growth, and to minimize damage to orchard equipment and infrastructure.
- Treat fungal diseases to maintain the health and vigor of the orchard trees used for seed production, and the native plant species (at Sprague) for seed production. Also, to control plant pathogens in the native seedling grow-out beds.
- Minimize animal damage to orchard trees, native plant beds (at Sprague), and orchard equipment and infrastructure.

1.1.2 Need for Action

The need for action is demonstrated by both orchards' experience with periodic problems from insects, disease, weeds, and animals. These pests are described in the following paragraphs. Appendix A contains detailed information on the more common and damaging insects and diseases at the Provolt and Sprague Seed Orchards.

1.1.2.1 Insects

The seed orchards' locations are somewhat isolated from natural stands of orchard trees (sugar pine), which probably helps reduce the natural load of insects specific to the species. However, many insects known and capable of causing serious injury to Douglas-fir at Provolt and pine species at Sprague are present in the lands near the orchards. These are adult flying insects, capable of reaching orchard lands from outlying mountain areas.

At Provolt, insects which cause damage to Douglas-fir cones on the trees in the orchard, are the Douglas-fir cone worm (*Dioryctria abietivorella*), Douglas-fir cone moth (*Barbara colfaxiana)*, Douglas-fir cone gall midge (*Contarinia oregonensis)*, western conifer seed bug (*Leptoglosses occidentalis*), and the Douglas-fir seed chalcid (*Megastigmus spermotrophus*). All of these insects cause varying amounts of damage but the cone worm is the most significant. The Provolt Seed Orchard was used in a gall midge study in 2000 and 2001 by Simon Fraser University (British Columbia, Canada) researchers to test pheromones.

Part of the study revealed the presence of Douglas-fir cone gall midge in the orchard and some limited damage to cones and seeds. Douglas-fir twig weevil (*Cylindrocopturus furnissi*) also can be problem. Bark beetles and boring insects such as the Douglas-fir beetle (*Dendroctonus pseudotsugae*), Douglas-fir engraver beetle (*Scolytus unispinosus*), fir engraver beetle (*Scolytus ventralis*), and the flat headed borer (*Melanophila drummondi*) will tunnel through the outer stem bark into living tissue of stressed trees and sometimes healthy trees, and introduce fungi which cause damage and mortality. Infected trees are removed quickly from the orchard.

At Sprague, potentially damaging insects include the fir cone worm (*Dioryctria abietivorella*), western conifer seed bug (*Leptoglossus occidentalis*), a species of cone borer (*Eucosma* spp.), and the sugar pine cone beetle (*Conophthorus lambertiana*). The cone beetle is a serious cone-damaging insect to sugar pines in the forests of southern Oregon, but as yet has been seldom found in the orchard. Bark beetles and boring insects such as the red turpentine beetle (*Dendroctonus valens*) and mountain pine beetle (*Dendroctonus ponderosae*) will tunnel through the outer stem bark into living tissue of stressed trees and sometimes healthy trees, and introduce fungi which cause damage and mortality. Infected trees are removed quickly from the orchard.

Most types of detrimental insects have caused limited amounts of tree damage, including stress; deformation of tree stem, roots, branches, needles, or buds; damage to pollen, cones, and seeds; and mortality. Generally, the adult insects lay eggs on trees. The larval stages of these insects then tunnel into tree parts and eat tissue, destroying or deforming the tree parts, or the adult insect will bore into seeds to remove the contents. Larvae will often form pupae in or on the tree parts, such as in the bark or cones, and overwinter until the following spring when they emerge as adults, thus completing the life cycle.

Healthy, vigorous trees are able to withstand occasional or limited attacks of foliar, bark, or root insects and recover with little damage. However, large numbers of cone and seed insects are present in the orchards every year, and are capable of causing heavy damage to seed crops. A variety of control measures can generally limit the effects of most insects to minor or acceptable amounts of damage. The exceptions are cone and seed insects, and insect population bursts and very localized small outbreaks of other insects. Many serious bark-boring insects attack trees that are larger and older than those currently found in the orchards. Thus, the risk to tree survival will increase in future years when the orchard trees mature further. Also, insect populations will slowly increase in the orchards and surrounding areas as the trees become older and produce more cones (due to a slow building and survival of these insect populations), increasing the risk of population bursts and resulting damage.

1.1.2.2 Disease

The location of each seed orchard probably helps isolate it from some of the serious root diseases that may otherwise affect cultivated species in a forest environment. Specifically:

- Provolt is on agricultural lands outside of the southern Oregon forest stands of Douglas-fir. Pathogens such as *Armillaria* root disease (*Armillaria ostoyae* and *Armillaria mellea*), laminated root disease (*Phellinus weirii*), and black stain root disease (*Leptographium wageneri*) are some of the more aggressive diseases affecting Douglas-fir in the forest. Some of these pathogens may also be present in the orchard soils, but are passive and have caused very little damage to orchard trees.

- Sprague is on mixed conifer and hardwood forest lands, somewhat isolated from the primary southern Oregon forest stands of mixed conifers. Pathogens such as *Armillaria* root disease, annosus root disease (*Heterobasidion annosum*), *Phytophthora* root disease, and white pine blister rust (*Cronartium ribicola*) are some of the more

aggressive diseases affecting sugar pine in the forest. Sugar pine grows naturally in the southern Oregon forests as a minor (in numbers) conifer component, not in pure forest stands (such as Douglas-fir often grows) and as is designed in a seed orchard. Some of these pathogens are present also in the orchard and, although they are normally passive, they have caused varying (but generally limited) amounts of damage to orchard trees. Root diseases cause mortality annually, but seem to be aggressive in pockets or small areas in the orchard where stress factors are present, such as high water table, poor root conditions from seedling handling methods, lack of water, or extreme temperatures.

Foliar diseases have also affected orchard trees in small outbreaks and limited areas. Douglas-fir rust (*Melampsora occidentali*), *Phomopsis* canker (*Phomopsis lokoyae*), and *Rhabdocline* needle cast have been found occasionally at Provolt. The sugar pines at Sprague and Provolt are susceptible to white pine blister rust, an exotic fungus which affects the stem, branches, and needles. The sugar pines at Sprague and Provolt are selected based on types and levels of blister rust resistance identified from blister rust screenings and analysis of results. However, despite the blister rust resistance levels and mechanisms, the pathogen is capable of infecting and damaging branches and sometimes whole trees. *Atropellis* canker in sugar pine, and *Lophodermella* needle casts in sugar pine (and in ponderosa pine at Sprague), have been found occasionally, causing minor damage and no mortality. The trees suffer foliage or branch damage and needle drop plus some stress, but the affect is temporary and the recovery has been good. In the forests of southern Oregon, these diseases can cause greater amounts of damage, such as growth loss, top kill and deformation, but generally only killing small trees. When the trees are healthy, all of these diseases, except blister rust, cause minor damage such as branch or stem deformation, and loss of vigor and growth. Except for white pine blister rust, these diseases seldom result in mortality.

Most of these diseases become aggressive in stress situations, when trees are lacking sufficient moisture or nutrients, when environmental conditions are severe, or when humans or animals cause damage to trees. Sunscald, high temperatures, frost, prolonged high water table, drought, unusual rainy periods, or other extreme conditions such as wind and heavy snow can cause physical injury, weaken a tree, and expose it to diseases. Management and cultural practices in the orchards can reduce the risk of injury and stress, thus reducing the risk of disease. Disease outbreaks in severe conditions can be a future problem as trees mature.

1.1.2.3 Vegetation

Wanted and unwanted vegetation occurs in many forms and locations throughout both orchards. A variety of unwanted native and exotic herbaceous vegetation, mostly grasses and broad leaf plants, are found along fence lines and roadways, around buildings, along irrigation ditches and the edges of ponds, around the perimeters of orchard units, on the edges of undeveloped riparian or wooded areas, in and around the administration sites (including around parking lots, walkways, storage areas, fuel tanks), in fallow areas that are developed but not planted with conifers, and in special use areas (such as flood damaged restoration areas and hardwood production areas at Provolt, and the native species gardens at Sprague).

Unwanted woody hardwood and conifer tree and shrub species grow from sprouts or seeds in border or edge areas along fence lines and roads, along riparian areas, or in fallow areas. Blackberry species, black cottonwood, red alder, pines and cedars, sedges, willows, and, at Sprague, poison oak often create hazards or impediments to normal orchard operations. Other vegetation introduces contaminating "weed" seed into pure native plant seed beds, affecting the quality of the source seed being produced.

Noxious weeds are a type of unwanted (and in many cases exotic) vegetation at both seed orchards, occurring in a variety of locations and conditions throughout the orchard lands. These plant species are officially designated as noxious weeds on county, state, and Federal lists for identification and control. Unwanted and uncontrolled vegetation provides fuel loading for potential wildfires. Provolt is in a rural community surrounded by farms and homes with acreage, where a county highway provides one border and a state highway divides the orchard nearly in half. Sprague is within a rural residential community surrounded by homes with acreage; county roads form two borders, with private roads found along or near two borders, and a Central Oregon and Pacific Railroad line passing through a section of the orchard. The risk of wildfire in the interfaces of orchard lands with public roads, homes, and, at Sprague, a railroad, is very high. The control of vegetation height in the orchard units, fallow open land areas, and borders is essential to reduce the rapid spread of grass fires. At Provolt, in the summer of 2000, a small wildfire in an orchard unit with short ground cover vegetation (controlled by tractor mowing) resulted in the loss of crop trees and irrigation system components. It demonstrated the rapid spread of fire in orchard cover crop and the importance of controlling the vegetation.

Competition for water, nutrients, and light among the orchard trees, and planted and maintained cover crop vegetation in the orchard units, occurs during the active growing season. Reduction of vegetation increases available soil moisture and nutrients to the trees. Unwanted and uncontrolled vegetation near orchard trees also is a physical barrier from efficient irrigation spray patterns of sprinklers and micro jet emitters. The uncontrolled vegetation is also a physical barrier to safe and efficient foot and vehicular travel.

Uncontrolled vegetation also provides protective hiding and nesting cover for rodents and other animals, which cause damage to orchard trees, irrigation systems, building foundations, road surfaces, and the lands in the orchard units. Rodents chew and eat tree roots and bark, and sometimes eat foliage. Rodents also chew and damage plastic irrigation lines and emitters and electrical wiring; burrow under concrete foundations, undermining building integrity; and burrow into roadways and throughout orchard units, causing erosion, degradation, and an uneven surface. Any uneven surface, in turn, creates a safety hazard when using high lifts, utility vehicles, or all-terrain vehicles (ATVs). Keeping vegetation low reduces animal cover and increases opportunity for predation on these animals by raptors and carnivores, thereby reducing the damage.

Because the perimeter fences surrounding the developed areas at each orchard (eight-foot high woven wire with partially buried smaller mesh wire at the bottom at Provolt; seven-foot high chain link with barbed wire at the top at Sprague) represent a very high capital investment, vegetation has been controlled along these fence lines. If left uncontrolled, this vegetation, especially blackberry, poison oak, Scotch broom and other aggressive plant species, would ultimately overgrow and affect the structural integrity of these fences and their ability to act as barriers.

1.1.2.4 Animal Pests

A wide variety of animal habitat exists in and around the seed orchards, including grass- and tree-covered orchard units, open grass-covered fallow areas, open woodlots, brushy hedgerows and edge areas, fence lines, and roadsides. Provolt also has irrigation ditches and ponds, a large river, and a major stream with riparian areas. Sprague has a small lake and intermittent drainages, culverts, and riparian areas. These habitats attract a wide mixed variety of animals, which live and feed in the orchard.

The seven miles of eight-foot high woven wire fence material at Provolt excludes big game from the orchard. A partially buried smaller mesh wire is attached to the base of the fence for a deterrent to rabbits. The developed orchard lands at Sprague are

protected with three and one half miles of seven-foot high chain link fence with barbed wire at the top, which acts as a big game exclosure. In the early development years, the fences were essential for keeping the black-tailed deer, black-tailed jack rabbit, and brush rabbit away from small tender seedlings and grafted trees, as well as expensive graft-compatible rootstock at Provolt and disease-resistant rootstock at Sprague. As the trees grew out of browsing reach from the deer and the bark thickness of older trees was no longer attractive to rabbits, the fence continued to be an important deterrent from deer from doing antler damage to tree stems, to cows from wandering into the orchard (at Provolt), and to any large animals from doing damage to the irrigation system. Deer occasionally get into both orchards through open gates during the day when the orchards are open for business, or through gaps under the fence.

Rodents such as the western pocket gopher, and a variety of mice and voles, such as the long-tailed vole and deer mouse, all cause damage to young tree roots and lower stems by eating plant tissue. Older trees can be damaged by porcupines, which eat inner bark tissue and girdle the tree stem. At Sprague, porcupines caused serious damage to several orchard units of sugar pine in the early 1990s, until the animals were removed by trapping and shooting. Ground squirrels tunnel around the foundations of buildings, in and near roads, and in the orchard lands, creating hazards to facilities and people. Beaver at both orchards cause damage to hardwood trees and conifers along the perimeter of ponds and the Sprague lake.

Other animals cause damage to portions of the irrigation systems at each orchard (1-inch poly supply line, ¼-inch poly supply line, plastic risers, and emitters). The coyote, gray fox, opossum, striped and spotted skunk, raccoon, domestic dogs, and some of the rodents listed above chew off and remove, or chew holes in, the irrigation system parts, which causes leaks and water loss, requires time and money to repair, and prevents the trees from getting water.

At Sprague, the western gray squirrel can cause great amounts of damage and loss to cones on the trees, and could easily destroy an entire crop of cones. The squirrels come into the orchard from adjacent woodlands to hunt in the orchard for food, including the cones hanging on orchard trees in the insect protection bags.

Some animals causing damage are also predators for other animals that damage orchard crops. Animals are generally welcome and accepted at Provolt and Sprague until populations rise, food preferences shift to orchard crops, or damage becomes unacceptable.

1.2 Location of Provolt and Sprague Seed Orchards

Figure 1.2-1 shows the locations of the Provolt and Sprague Seed Orchards.

1.2.1 Provolt Seed Orchard

The Provolt Seed Orchard is located approximately 15 miles southeast of the city of Grants Pass and 25 miles west of Medford, Oregon, near the small community of Provolt and within Josephine and Jackson Counties. It lies within the Applegate River valley of the Klamath Mountains province.

1.2.2 Sprague Seed Orchard

The Sprague Seed Orchard is located approximately ten miles northwest of the city of Grants Pass and 40 miles northwest of Medford, Oregon, near the small community of Merlin and within Josephine County. It lies within the Jump-off Joe Creek valley of the Klamath Mountains province.

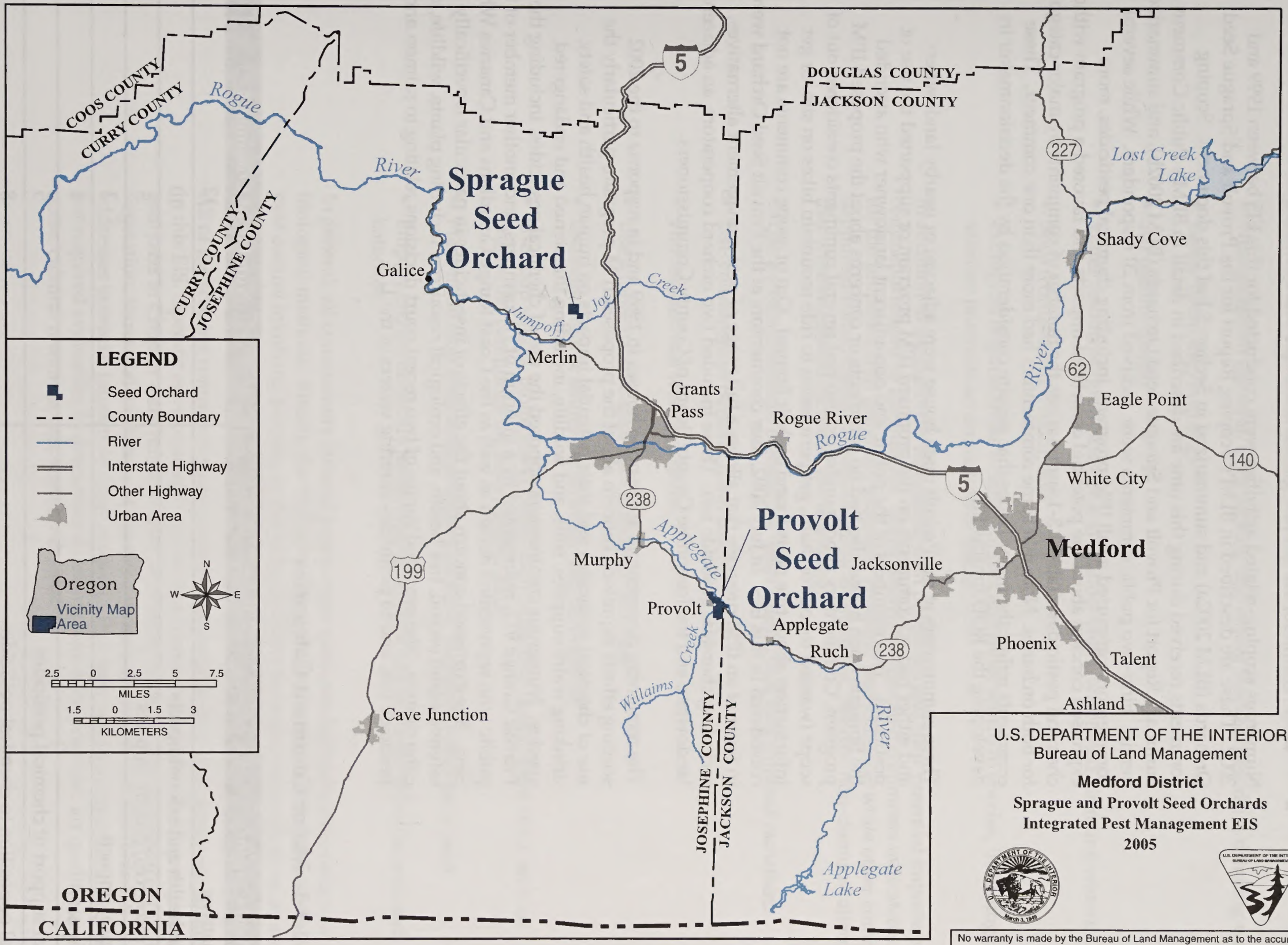

Figure 1.2-1: Location of Sprague and Provolt

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

Medford District
Sprague and Provolt Seed Orchards
Integrated Pest Management EIS
2005

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1.3 Scoping Comments and Issues

Numerous scoping-related activities were conducted for this EIS between 1999 and 2002. These are described in BLM's Scoping Report for the Provolt and Sprague Seed Orchards (BLM 2002a) and summarized in Section 5.1 of this document. Scoping comments received during this time are described in detail in BLM's Public Comment Summary Report for Provolt and Sprague Seed Orchards (BLM 2002b), and summarized herein. Fifty-two public comments were received from 20 responders. While several commentors supported a full IPM program, including chemical pesticides, more expressed concern about the potential associated impacts and favored a program without chemical pesticides. Table 1.3-1 summarizes the number of comments by major category for both orchards. Note that some commentors had more than one comment. These comments reflect the major issues that require consideration by the decisionmaker in developing the ROD for this EIS.

Three commentors at the Provolt open house were adjacent or nearby landowners and either had no comments on the proposed IPM program or supported the use of pesticides. Two members of the public and one adjacent landowner who attended the Sprague open house also had no comments or concerns about the proposed IPM program. Commentors at both orchards also had several comments considered out of scope (wanted to tour orchard, get permission to ride mountain bikes on site, or get information about tree pests found at their homes). Out of scope comments are not considered in this EIS. In July 2002, four commentors at the Provolt Seed Orchard were in favor of an IPM program that allows a full range of pest management alternatives, including chemical pesticide use. These included two orchard cooperators, an adjacent landowner, and the Josephine County Board of County Commissioners.

The remaining commentors at the open houses in 1999 and in response to the 2002 scoping efforts expressed concern about the proposed IPM program, particularly the use of chemical pesticides and their potential impacts on human health and safety, drinking water supplies, soils, and wildlife, including threatened and endangered species. Numerous commentors opposed the use of chemical pesticides, including the Provolt Grange 912, represented by a quorum of 70 members, and another member of the public who represented herself as well as the Coast Range Guardians and Canaries Who Sing. She expressed concern about the effects of insecticides in particular (specifically esfenvalerate) on soil, tree health, and ecological resources, including plants, wildlife, and coho salmon. She provided copies of two recent court decisions relating to salmon and pesticide use, and to pesticides entering waters of the U.S.

Table 1.3-1. Major Comment Categories

Comment Category	Number of Comments
Alternatives	12
Human health and safety impacts	10
Water resources/quality impacts	5
Ecological impacts	3
Soil impacts	4
General support of chemical pesticides	5
General opposition to chemical pesticides	8
No comment/out of scope	5
Total Comments	**52**

Specific environmental impact concerns associated with potential use of chemical pesticides and expressed during scoping are identified below:

- Human health (general, from picking and eating blackberries, drift, drinking water);
- Safety (from fire/burning);
- Air quality (drift);
- Water resources (groundwater and shallow wells, watershed, drinking water);
- Soils (contaminated food); and
- Ecological impacts (risks to large raptors and other sensitive species, including coho salmon; potential accumulation of toxins).

In addition to the concerns associated with pesticides and their potential impacts, many comments related to alternatives. Many alternatives-related comments indicated support for the proposed IPM program, including chemical pesticide use, while other comments supported consideration of non-chemical alternatives. Specific non-chemical alternatives that were suggested included the following:

- Use a steam treatment method for weed control that uses infrared radiation;
- Use volunteers to perform hand labor on pests;
- Harvest and sell weeds as herbs;
- Use a more passive approach like raptor perches;
- Use only organic sources of fertilizer and pest control;
- Use soap sprays, biological controls such as *Bacillus thuringiensis* (*B.t.*), and/or enhancing conditions for insect-eating birds;
- Plant more crop trees than necessary to allow for some loss of pests; and
- Employ environmentally benign methods such as placement of birdhouses and batboxes.

In general, all commentors favored pest control methods that included mechanical and biological methods. Finally, the Williams Fire and Rescue Chief recommended that any pest control involving burning at the orchard follow the same fire restrictions as are in place for the general public, to be consistent and to address potential safety concerns.

All of the scoping comments received and considered to be within scope are addressed in this EIS. Specific environmental resources of concern identified during scoping and analyzed in Chapter 4 are human health and safety, soils, ecological resources (including vegetation, terrestrial wildlife, and aquatic species), and water quality. This EIS also addresses potential impacts to other resources that were not identified during scoping, but required evaluation to determine if any impacts were possible: air quality, land use, noise, cultural resources, and socioeconomics.

1.4 Relationship to Plans, Policies, and Programs

1.4.1 Related BLM Plans, Policies, and Programs

The Medford District Resource Management Plan (RMP) (BLM 1995) included the seed orchards within the District Defined Reserve system. These reserves were established for protection of specific resources, flora and fauna, and other values. These seed orchard values included preservation of genetic materials, production of improved seed, and various orchard developments and facilities.

The provisions of the Medford District RMP found in the resource program sections for Energy and Minerals; Land Tenure Adjustments; Rights-of-Way, Access, and Withdrawals; and the information in Appendices D—Best Management Practices-Roads and Landings, and F—Forest Genetics Program, apply to the Provolt and Sprague Seed Orchards. Except for these specific sections, the objectives and management actions/direction described in the Medford District RMP are not applicable to Provolt and Sprague.

A categorical exclusion (CX) was prepared in 1996 for the use of pesticides for insect and disease control in the greenhouse nursery at Sprague (BLM 1996)

The Sprague Seed Orchard is administratively withdrawn. Section 204 of the *Federal Land Policy and Management Act* (FLPMA) of 1976 (43 U.S.C. 1700 et seq.) describes "withdrawal" as "withholding an area of Federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area or reserving the area for a particular public purpose or program." It was noted as a public land withdrawal under the Medford District RMP (BLM 1995). Specifically, Public Land Order (PLO) 4132 withdrew the 200 acres at the seed orchard from entry under general land laws and mining laws. The Provolt Seed Orchard is entirely on acquired lands which were formerly in agricultural use, are not subject to withdrawals under PLOs, and are exempt from general land and mining laws.

BLM's Oregon State Office concluded that these intensively developed sites were not intended to meet the standards and guidelines for forest health as generally provided in the Medford District RMP, which incorporated and superceded the Northwest Forest Plan (BLM 2000). In addition, standards and guidelines for various resources, such as Survey and Manage and Protection Buffer Species, while applicable to many administrative withdrawals, are not intended to be applied to intensively developed and used areas, such as the Provolt and Sprague Seed Orchards (BLM 2000). The orchards are not considered appropriate or available for conversion to a late-successional reserve or any other land use allocation which might directly serve as scarce or important habitat (BLM 2000). BLM's findings distinguish the unique nature of these sites from other administrative withdrawals, such as Research Natural Areas, which are designed and designated to be important components of the broad ecosystem management direction under the RMP.

BLM prepared and supplemented an EIS for Port-Orford-cedar management in southwest Oregon (BLM 2004). The Provolt and Sprague Seed Orchards will follow all relevant recommendations contained in the ROD for the Port-Orford-cedar management EIS. Both seed orchards are outside of the natural range of the species, and do not propagate the species in production orchard units or preservation units and have no plans to propagate the species for seed or protection in either orchard at this time. The Provolt Orchard has two temporary test rows (about 50 seedlings, 10 years old) of Port-Orford-cedar to test the survival, growth, and adaptability of the species at the orchard. The Provolt Orchard is downstream (Williams Creek) of Port-Orford-cedar sites, and the Sprague Orchard is not near or connected by waterways to sites containing Port-

Orford-cedar. Irrigation water used for the test rows and nearly all other orchard trees at the Provolt Orchard comes from a groundwater spring source. Some Provolt orchard areas west of Williams Creek are irrigated with surface water from Williams Creek and the Applegate River via an irrigation ditch. All irrigation water used at the Sprague Orchard comes from groundwater wells. Regardless of the alternative selected in the ROD for Port-Orford-cedar management and applied to management of the species, both orchards would apply any appropriate existing management direction in its activities now. In addition, the Port-Orford-cedar Risk Key (site-specific analysis to help determine where risk reduction or mitigation treatments would be applied) and all appropriate management practices would be selected and implemented where there is a need, based on the Risk Key. The Risk Key and a list of management practices can be found in Chapter 2 of the *Draft Supplemental Environmental Impact Statement: Management of Port-Orford-Cedar in Southwest Oregon* (BLM 2003).

BLM prepared and supplemented a programmatic-level EIS for Northwest Area Noxious Weed Control (BLM 1987). The ROD authorized use of specific herbicide formulations to control noxious weeds. The herbicide products contain dicamba, glyphosate, picloram, or 2,4-D as the active ingredient. Noxious weed control projects at Provolt and Sprague using these herbicides would be authorized under this 1987 ROD, and by the 1998 BLM project-specific EA for glyphosate use within the Medford District between 1999 and 2002 (BLM 1998). Subsequent to the 1987 noxious weed control EIS, BLM prepared an EIS and ROD for the Western Oregon Program for Management of Competing Vegetation (BLM 1992b). This ROD selected an IPM approach with a preference for non-herbicide methods, and applies to all BLM-administered land in the Coos Bay, Eugene, Medford, Roseburg, and Salem Districts, and part of the Lakeview District. Actions covered under the 1987 Noxious Weed Control EIS are excepted from this decision.

There is currently an injunction prohibiting BLM from applying herbicides. It has been partially lifted to allow applications for noxious weeds, as covered under the NEPA documents described in the preceding paragraph. Except for these uses, the injunction would have to be lifted (in its entirety or specifically for the seed orchards) before herbicides could be used as described in this EIS.

BLM is undertaking a programmatic EIS for vegetation treatment on public lands administered by the BLM in the western U.S., including Alaska. This programmatic EIS will consolidate, update, and replace analyses contained in existing BLM vegetation treatment EISs, as well as include lands not analyzed in the existing documents. The programmatic EIS is not intended to affect specific Agency management decisions developed under local land-use plans, but will provide a baseline cumulative impact assessment that local BLM offices, including the Medford District Office, can use as they develop or update each district land use plan/EIS. The public scoping comment period on the programmatic EIS ended March 29, 2002. The programmatic Draft EIS was not published as of the date this seed orchard IPM Final EIS went into publication.

In the absence of this IPM EIS, Medford has prepared project-specific EAs for past glyphosate use, as noted above, and for esfenvalerate use for cone insect control in sugar pine at Sprague between 1992 and 1996 (BLM 1992a). Once a decision is issued on the basis of this EIS, however, such project-specific NEPA documentation should no longer be required at Provolt or Sprague, since the ROD will make available to the seed orchard manager a variety of pest control methods that can be implemented to control specific pests in a manner that best fulfills orchard goals.

BLM's Salem and Eugene Districts in western Oregon are developing pest management EISs for their two seed orchards concurrently with this one for Medford. Specifically, the Salem District is developing an EIS for the Horning Seed Orchard, and the Eugene District is developing a second EIS for the Tyrrell Seed Orchard. Both EISs are being prepared under the same project schedule as this EIS for Provolt and Sprague.

1.4.2 Relevant Federal, State, and Local Statutes and Guidelines

Pest management at the Provolt and Sprague Seed Orchards would follow all relevant Federal, State, and local laws and regulations. Major legislation relating to this EIS includes the following.

- *National Environmental Policy Act of 1969* (42 U.S.C. 4321 et seq.), as amended: requires Federal agencies to prepare an EIS if a proposed action has a potential for significant environmental impacts.

- *The Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA) of 1947, as amended (7 U.S.C. 136 et seq.): establishes procedures for the registration, classification, and regulation of all pesticides. The Environmental Protection Agency (EPA) is responsible for implementing FIFRA; primary enforcement responsibilities for use-related violations are assigned to states with approved programs. Before any pesticide may be sold legally, it must be registered by EPA. EPA may classify a pesticide for unrestricted use if it determines that the pesticide is not likely to cause unreasonable adverse effects on applicators or the environment. States may classify pesticides for restricted use (which means they may be applied only by or under the direct supervision of a certified applicator or in accordance with other restrictions), even though EPA may not have done so.

- *The Clean Air Act*, as amended (42 U.S.C. 1857 et seq.): sets national primary and secondary ambient air quality standards, requires that specific emission increases be evaluated to prevent a significant deterioration in air quality, and provides EPA with authority to set national standards for performance of new stationary sources of air pollutants and standards for emissions of hazardous air pollutants.

- *The Clean Water Act* (33 U.S.C. 1251-1387) of 1984, as amended: charges EPA with protecting the nation's water resources and wetlands, and controlling the discharge of toxic chemicals. The Act defines water quality standards for priority toxic pollutants, oversees the industrial pre-treatment program, and provides local governments with the authority to control non-industrial discharges of toxics.

- *The Safe Drinking Water Act* (SDWA) of 1974 (42 U.S.C. 300(f) et seq.): established a national structure for drinking water protection activities. The Act authorized EPA to establish national, enforceable health standards for contaminants in drinking water; provided for public water system compliance through a Federal-state partnership; established public notification to alert customers to water system violations; and set up procedures to protect underground sources of drinking water.

  The 1996 amendments to the SDWA required states to develop source water assessment programs (SWAPs) that outline an approach for conducting source water assessments, delineate the boundaries of areas from which public drinking water systems receive drinking water, and identify the origins of regulated and unregulated contaminants. In Oregon, the Oregon Department of Environmental Quality (ODEQ) has state primacy for implementing the SDWA and administers both the SWAP and the Underground Injection Control (UIC) program through this authorization. Through both the SWAP and UIC programs, ODEQ seeks to ensure the protection of groundwater that is used for drinking water. BLM supports ODEQ's efforts by contributing data and information to ODEQ's UIC registry of sites. Among the sites registered under ODEQ's UIC program are Class V injection wells. EPA Region 10 defines Class V injection wells to be systems, structures, or activities that allow for subsurface placement of fluid directly. In most instances a hole or a trench using piping would qualify if the purpose or intent is for subsurface discharge either through infiltration or injection. Operation and maintenance activities at the Provolt and Sprague Seed Orchards do not involve subsurface placement (that is, injection)

of potential contaminants and therefore have not been registered with ODEQ. However, because the potential for an unintended spill or discharge always exists, best management practices for spill recovery that reference ODEQ's UIC best management practices (ODEQ 1999) would be developed and included in an emergency response plan.

- *The Endangered Species Act* (ESA) of 1973 (as amended): establishes Federal policies and procedures for protecting endangered and threatened species of fish, wildlife, and plants. Section 7 requires Federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) or the National Oceanic and Atmospheric Administration's Office of Fisheries (NOAA Fisheries) (formerly known as the National Marine Fisheries Service, or NMFS) to ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued survival of a listed species or result in the adverse modification or destruction of its critical habitat (16 U.S.C. 1536 (a) (2)). In addition, the Act requires that if species proposed for listing are likely to be jeopardized, consultation must be held with the FWS or NOAA Fisheries. This consultation may result in modification or abandonment of an action.

  Biological Assessments were prepared to document the Section 7 consultation process for the proposed IPM program. BLM concluded that implementation of the proposed IPM alternative may affect, but is not likely to adversely affect, southern Oregon/northern California coasts coho salmon or their designated critical habitat. See Section 4.7.3 for additional details. NOAA Fisheries issued biological opinions concluding that the proposed action is not likely to jeopardize the continued existence of threatened coho salmon; the opinions specified reasonable and prudent measures, with associated terms and conditions, to further protect the species. See Section 2.3.3 for additional details.

- *Migratory Bird Treaty Act* (16 U.S.C. 703-711): except as allowed by implementing regulations, this act makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products.

- *Fish and Wildlife Coordination Act* of 1980 (16 U.S.C. 2901 et seq.): encourages Federal agencies to conserve and promote conservation of nongame fish and wildlife and their habitats to the maximum extent possible within each agency's statutory responsibilities.

- *Magnuson-Stevens Fisheries Conservation and Management Act*, as amended by the Sustainable Fisheries Act of 1996: requires the identification and protection of essential fish habitat (EFH) for important Federally managed fisheries resources (that is, marine and anadromous fisheries). In freshwater, EFH includes habitats for spawning and incubation, juvenile rearing, juvenile migration corridors, and adult migration corridors. Federal agencies are required to consult with NOAA Fisheries if their actions may adversely affect EFH. The ESA consultation process with NOAA Fisheries included evaluation of EFH impacts. In the biological opinions, NOAA fisheries concluded that the proposed action may adversly affect EFH for chinook and coho salmon. NOAA further recommeneded that the first three terms and conditions are specified for ESA compliance be adopted as EFH conservation measures. The biological opsinions are provided as Appendix F to this Final EIS.

With respect to the ESA, the U.S. District Court in Seattle ruled on a case between the Washington Toxics Coalition and EPA on July 3, 2002 (*Washington Toxics Coalition et al. v. Environmental Protection Agency and Christine Todd Whitman, Administrator*). The purpose of this lawsuit was to compel EPA to consult with NOAA Fisheries (formerly NMFS) over its registrations of pesticides known to affect fish. The court found that EPA was in violation of ESA because EPA had not consulted with NOAA Fisheries, and determined

that EPA needed to consult with them on 54 of the pesticides identified in the case, eight of which are proposed for use at Provolt and Sprague (acephate, chlorothalonil, chlorpyrifos, diazinon, dicamba, dimethoate, propargite, and triclopyr). Although the Court issued an interim injunction specifying no-spray buffers for ground and aerial applications of subject pesticides, specific agency actions such as the proposed action described in this Final EIS are excluded from the injunction by issuance of a no-jeopardy biological opinion from NMFS, as is the case for this proposed action.

In another lawsuit, the League of Wilderness and seven other environmental groups appealed a district court finding to the U.S. Court of Appeals for the Ninth Circuit, challenging the U.S. Forest Service's annual aerial insecticide spraying program covering over 628,000 acres of national forest lands in Washington and Oregon [*League of Wilderness Defenders et al. v. Harv Forsgren and U.S. Forest Service*, 309 F.3d 1181 9th Cir. (2002)]. The spraying was aimed at controlling a predicted outbreak of the Douglas-fir tussock moth, and included planned direct overspray of natural bodies of water during the course of treating forested areas. The plaintiffs asserted that the EIS was inadequate, and that the Forest Service failed to obtain a National Pollutant Discharge Elimination System (NPDES) permit, which is required by the *Clean Water Act* for point source pollutant discharges to water. Although the district court had granted summary judgment in favor of the Forest Service, the Ninth Circuit reversed the decision on appeal in an opinion issued on November 4, 2002. EPA issued an interpretive memorandum of the Ninth Circuit court's opinion on September 3, 2003 (EPA 2003). EPA stated that they believe the court misinterpreted EPA's regulations regarding NPDES permits, and that they will only follow the ruling within the Ninth Circuit court's area of jurisdiction (which includes Oregon). EPA is now proposing to codify the substance of the inperpretive statement in regulation and finalize the rule. Within this region, EPA stated that they will require NPDES permits only for applications of pesticides directly over and into waters of the U.S. that do not comply with relevant FIFRA requirements. No such applications are part of BLM's proposed seed orchard IPM program.

A new threat to woodlands, forests, and nurseries was identified in 2000, with the discovery of the pathogen *Phytophthora ramorum* in California, which causes a disease known as sudden oak death (SOD). It has a broad host range including hardwoods, landscape plants, herbaceous plants, and softwoods, and causes branch and twig dieback in conifers (USDA 2003). In Oregon, SOD was identified on forest lands in one county (Curry), where the host plants in the nine-square-mile infested area were destroyed. It was later identified in containerized plants at an Oregon nursery, prompting creation of an annual statewide inspection and certification program of plant growers and dealers. The U.S. Department of Agriculture recently issued an order specifying restrictions and certifications for interstate movement of nursery stock from quarantined areas (including the site of the previous infestation in Curry County) and regulated areas (including the rest of the state of Oregon), to prevent the spread of SOD to other parts of the U.S. beyond Oregon and California (USDA 2004). BLM monitors information bulletins from the Oregon Department of Agriculture and follows all relevant Federal, State, and local regulations and recommendations regarding SOD containment, prevention, and eradication.

BLM's pest management would be conducted in accordance with all applicable state and local government regulations, including two laws specific to the Department of the Interior and BLM: the *Sikes Act* (16 U.S.C. 670 et seq.), as amended, and FLPMA. The Sikes Act authorizes the Department of the Interior, in cooperation with state agencies responsible for the administration of fish and game laws, to plan, develop, maintain, and coordinate programs for the conservation and rehabilitation of wildlife, fish and game on public lands within its jurisdiction. FLPMA requires BLM to manage public lands and their resources for multiple use, and to develop resource management plans for lands under BLM's jurisdiction.

State and county weed control laws place responsibility for noxious weed control on individual land owners, including the Federal government. Permittees and grantees operating rights-of-way on BLM-administered land are required to comply with Department of the Interior herbicide use regulations. BLM must also coordinate with appropriate state agencies in managing state-listed plant and animal species when a state has formally made such designations.

1.5 Organization of This EIS

This document is organized into four main chapters. Background and support information, including a summary of the human health and ecological risk assessments, is provided in the appendices. The Final EIS presents four alternatives for managing pests at the Provolt and Sprague Seed Orchards, including the no action alternative, and examines the potential environmental impacts of each alternative. Chapter 1, Purpose and Need, identifies the purpose and need for action, provides an introduction to typical pests found at the orchards, and discusses the public issues surrounding pest management and other considerations. Chapter 2, Alternatives, presents and compares the alternatives, with information on how they would be implemented with measures to protect the environment. Chapter 3, Affected Environment, includes a description of the physical, biological, and social setting of the orchards. Chapter 4, Environmental Consequences, addresses changes likely to occur with implementation of any of the alternatives.

In addition to the four main chapters, the document contains these sections: Executive Summary; Table of Contents; Chapter 5—Consultation and Coordination (including scoping process, consultation list, and a list of agencies, organizations, and individuals to whom copies of the statement were sent); Chapter 6—List of Preparers; Chapter 7—References; a list of acronyms; a glossary; and an index.

Additional detail and background information is presented in appendices:

A. Seed Orchard Pests
B. Monitoring Plan
C. Risk Assessment Summary
D. Risk Assessment of Sublethal Effects for Special Status Aquatic Species
E. Public Comments on Draft EIS and BLM Responses
F. NOAA Fisheries Biological Opinion Transmittal Letter and Biological Opinion

2.0 Description of Alternatives, Including the Proposed Action

2.1 Background

2.1.1 Seed Orchards, Tree Improvement Program, and Genetics

BLM manages four centralized tree seed orchards in western Oregon: Provolt and Sprague in the Medford District, Horning in the Salem District, and Tyrrell in the Eugene District. Historically, the seed orchards' role was to provide genetically improved Douglas-fir and sugar pine seed and seedlings to the five western Oregon districts and the western Klamath Falls resource area for reforestation and progeny test programs. A major shift in management emphasis in the districts' RMPs sharply decreased the need for seeds for reforestation. Therefore, the seed needed for BLM purposes from the BLM seed orchards was greatly reduced. To allow BLM to cost-effectively manage the seed orchards, an effort has been made to share the seed orchards with other cooperators. Consequently, the seed needs from many of the orchard units have increased because of strong cooperator interest.

Orchard Operations

There are two types of BLM seed orchards, each serving a different purpose. In *breeding and preservation orchard units,* trees from the same clone/family are planted in tight spacing and located together. The main purpose of these orchard units is to breed for advanced generation programs and/or preserve genetic material (clone banks). They do not represent the total genetic variation selected within the breeding zone. This variation is more appropriately preserved in the progeny test sites. In *seed production orchard units,* trees from different clones/families within the same seed zone are planted at wider spacing and are designed to facilitate good mixing of pollen and reduce self-pollination. The main purpose of the seed production orchard units is to produce genetically improved seed for reforestation. There are Phase I and Phase II seed production units. In most cases, the Phase I units have been established with the first generation clonal material, and will be the main source of seed for the current and next decade. Most of the Phase II units are undeveloped and are reserved for advanced generation orchards.

Provolt Seed Orchard

Provolt consists of 300 acres of Applegate River alluvial bench lands purchased in 1980 to 1982 from contiguous private landowners. The land use at the time of purchase was agricultural grazing and hay crop production, primarily for a large dairy farm. BLM converted and developed the land by plowing, disking, land planing, and rock removal. The orchard's infrastructure was formed in the 1980s and 1990s, including perimeter animal exclosure fencing, interior road construction, reconstruction and removal of site buildings, and the development of an irrigation system consisting of underground pipe distribution.

In 1986, the first Douglas-fir rootstock seedlings were planted. The first grafting work was done in 1988. Douglas-fir orchard unit development was completed in 1995, with a total of 17 orchard units representing southwest Oregon geographical and elevational cooperative breeding (seed) zones. In 1996, white pine blister rust disease-resistant sugar pine development began for future seed production and gene preservation. Provolt has shifted from the developmental stage of its first 20 years since land purchase, into a maintenance and seed production phase.

The orchard is not a naturally highly productive Douglas-fir or sugar pine site, because the well-drained alluvial soils and southern Oregon climate provide limiting soil moisture and temperature environmental factors. Irrigation, fertilization, and a variety of cultural, biological, mechanical, manual, and chemical applications are used to mitigate the limiting factors and to maintain healthy and vigorous orchard seed trees. Trees that are not under stress, and are free to grow without undue competition, or soil moisture and nutrient deficiency, are better able to sustain the presence and effects of insects, disease, and other pests. Without the necessary water, nutrients, and pest management, the trees could not survive on the site, and cone and seed production in sufficient quality and quantity would not be possible.

By conifer orchard standards, Provolt is a young seed orchard, with the oldest orchard units being 15 years old from graft, and most other orchard units being 8 to 12 years old. The first seed crops in the orchard occurred in 1995 to 2000, with very limited amounts of cones (50 to 100 bushels per year) and relatively low seed yields (0.1 to 0.2 pounds (lb) of seed per bushel of cones; good yields average 0.3 to 0.6 lb per bushel).

The BLM Provolt Seed Orchard and the Applegate River Watershed Council jointly manage a small two-acre native plant production area at Provolt. A variety of mostly hardwood plants (black cottonwood, willow, dogwood, bigleaf maple, red alder, ninebark, and Oregon ash) are propagated in containers or production bedrows for planting on Applegate River watershed lands for riparian restoration. American Forests – Global ReLeaf grants have funded the project for the past seven years.

Figure 2.1-1 depicts the layout of the Provolt Seed Orchard and its seed production units.

Sprague Seed Orchard

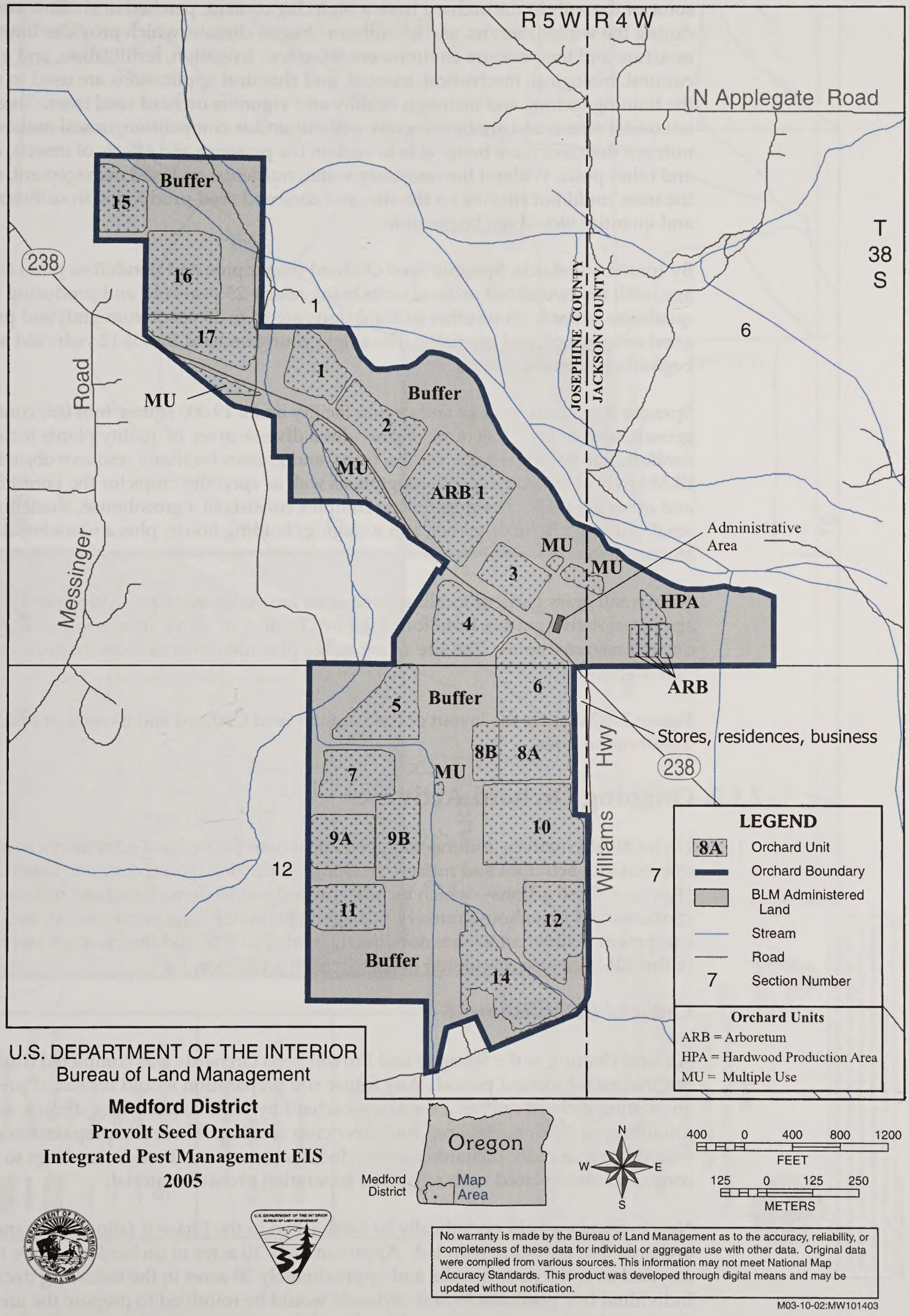
Sprague occupies 200 acres of former mixed conifer and hardwood forestland in the BLM-Medford District land base, which was harvested of trees and developed into a seed orchard in the mid to late 1960s. The flat to rolling lands were converted from forestland and developed into useable orchard land by harvest, stump removal, plowing, disking, land planing, and removal of rocks and wood. Perimeter animal exclosure fencing, interior road construction, building and infrastructure construction, and the development of an underground pipe irrigation system were mostly all constructed prior to the orchard dedication in 1969. BLM and the U.S. Forest Service jointly planned the orchard facility.

In 1974, the first sugar pine rootstock seedlings were planted, and the first grafting work for orchard unit development was begun in 1977. One ponderosa pine orchard unit's grafting work was also begun in 1977. Sugar pine orchard unit development was completed in 1993 with seven orchard units representing southwest Oregon geographical and elevational cooperative breeding (seed) zones. Five preservation arboretums have also been established to preserve the sugar pine genes of value in the program for the future.

The orchard was developed for the production of white pine blister rust resistant sugar pine seed for reforestation and restoration of an important conifer species suffering from the effects of this introduced exotic fungus disease. Nearly all of the seven production orchard units are now producing adequate to large amounts of cones and seed, and the orchard has shifted from the developmental stage of its first 30 years, to a maintenance and seed production phase. Seed is produced annually for the disease resistance sugar pine seed needs of BLM (Medford, Roseburg, and Klamath Falls offices), three National Forests, and seven private timber companies through cooperative agreements.

The orchard site sustained a native sugar pine and ponderosa pine component in the stands of trees on the site and in the surrounding area. The orchard site is not a naturally

Figure 2.1-1: Layout of Provolt Seed Orchard



highly productive sugar pine site because sugar pine requires well drained soils, and some of the soils in the orchard have a high clay content, perched or shallow water tables during the winter months, and a southern Oregon climate, which provides limiting soil moisture and temperature environmental factors. Irrigation, fertilization, and a variety of cultural, biological, mechanical, manual, and chemical applications are used to mitigate the limiting factors, and maintain healthy and vigorous orchard seed trees. Trees that are not under stress, and are free to grow without undue competition, or soil moisture and nutrient deficiency, are better able to sustain the presence and effects of insects, disease, and other pests. Without the necessary water, nutrients, and pest management, many of the trees could not survive on the site, and cone and seed production in sufficient quality and quantity would not be possible.

By conifer standards, Sprague Seed Orchard (sugar pine and ponderosa pine) is mid-age, with the two oldest orchard units being nearly 25 years old and producing large quantities of seed. Four other orchard units are 15 to 20 years from graft and producing good amounts of seed annually. The single young orchard unit is 12 years old and just beginning to produce seed.

Sprague has a cone storage and drying facility and a 19,000 square foot (ft^2) containerized greenhouse facility. This nursery provides a diverse array of quality plants including conifers, native hardwoods, shrubs, forbs, and grasses for many resource objectives on BLM lands in Oregon and Washington, as well as specialty crops for the Forest Service and other agencies. The greenhouse complex consists of a greenhouse, shadehouse, small cuttings chamber, cooler, and a staging/holding house, plus a work building and storage area.

Nine small grass gardens totaling three acres are maintained, producing seed from 20 species of native grasses from four Medford District resource areas and two Roseburg District resource areas. The site's long-range plan identifies 14 acres for grow-out of native species.

Figure 2.1-2 depicts the layout of the Sprague Seed Orchard and its seed production and preservation units.

2.1.2 Ongoing Orchard Activities

Under all alternatives, routine management actions for orchard establishment and maintenance activities and nursery seedling production would continue to occur. However, these actions—which include orchard establishment, orchard maintenance, containerized greenhouse nursery management, buffer zone management, and facilities/equipment maintenance—are not directly related to IPM and therefore are not evaluated in this EIS. See also discussion of District RMP in Section 1.4.1.

Orchard Establishment

All land clearing at the Sprague and Provolt Seed Orchards was completed during the original establishment period. Any future site preparation would consist of preparing an existing orchard unit area for a new orchard by removing existing stumps, subsoiling, rototilling or disking, leveling, and cover crop seeding. These site preparation activities would occur as older orchards are recycled; that is, as trees become too large to harvest cones and are replaced with advanced generation orchard material.

New orchards would periodically be established in the Phase II fallow areas and in orchards that are being recycled. Approximately 10 acres of orchard are likely to be recycled over the next decade, and approximately 30 acres in the following decade. Individual tree positions in new orchards would be rototilled to prepare the area for planting. Trees would be planted by shovel, tree spade, or power augur; mulched with

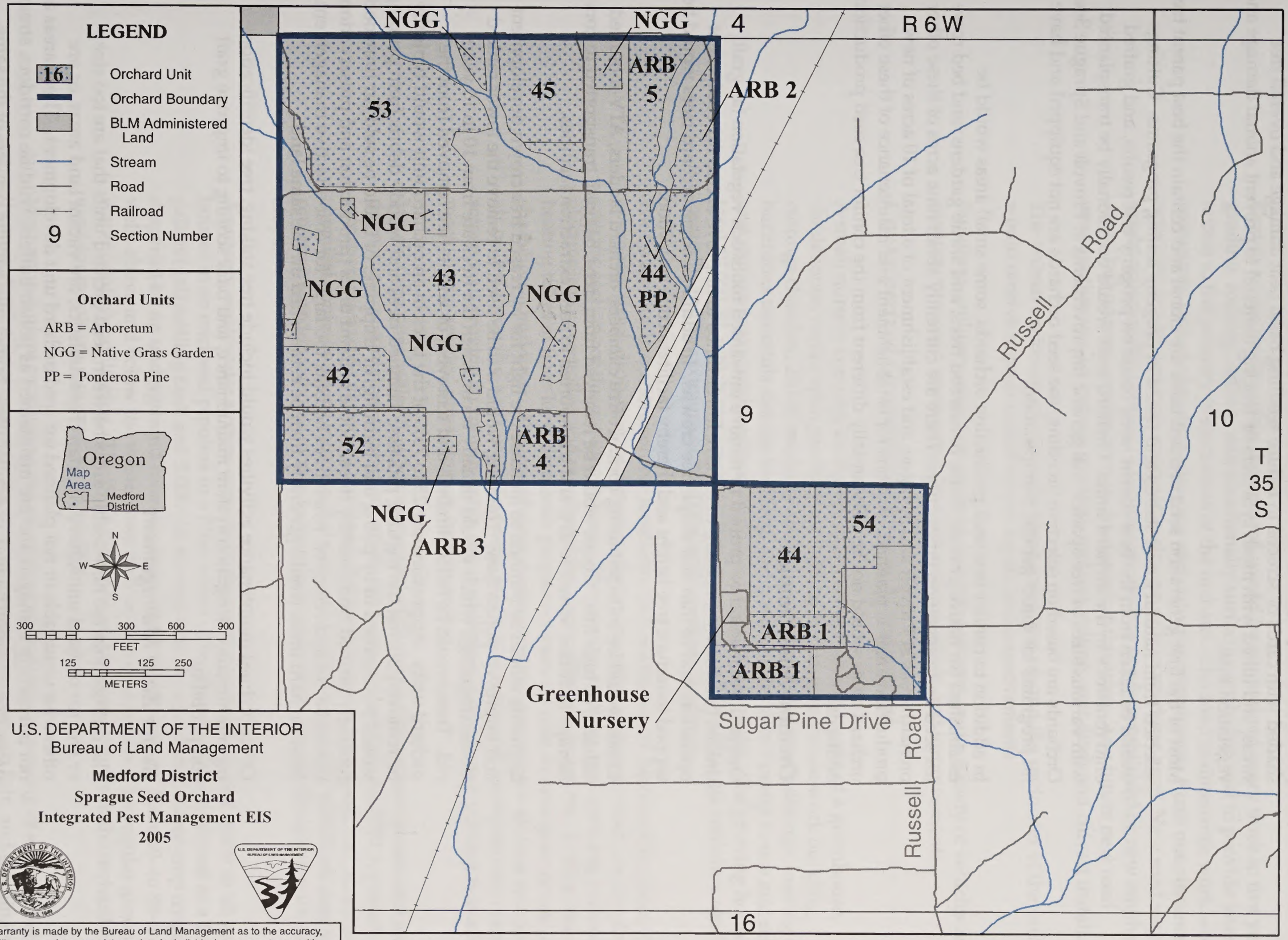


Figure 2.1-2: Layout of Sprague Seed Orchard

porous fiber or poly mats to help control competing vegetation and retain soil moisture; shaded with cards or screens to reduce seedling basal heat damage and overall tree stress; and tubed with mesh cylinders or fencing material to prevent animal damage and vegetation loss.

Most of the first generation seed orchard units are clonal and contain the best parent trees selected from natural forest stands and tested in progeny testing programs. Cuttings would be taken from the best parent trees, based on progeny test results, and grafted onto rootstock in the orchard units. Orchard trees would occasionally be transplanted with various sizes of tree spades. All genetic improvements at Provolt and Sprague Seed Orchards are based on selective breeding; the seed orchards are not equipped and have no programs for direct genetic manipulation.

In addition to conifer tree seed production orchards, some small areas would be established for native grasses, forbs, hardwood trees, and shrub gardens; and bed rows for seed and vegetation production. There are currently about nine acres of these other orchard areas at Provolt and Sprague, and establishment of a total of 10 acres of new production areas is planned. Actions for establishment and maintenance of these other orchard areas would not be substantially different from the conifer tree seed production orchards.

Orchard Maintenance

Orchard trees would be pruned to remove unwanted rootstock vegetation (as graft unions become established), to remove lower limbs to improve access for equipment operation, and to thin and shape tree crowns. In addition, some orchard trees would be topped to reduce tree height and thereby facilitate cone collection.

Cones would be collected using contract tree climbers, orchard ladders, ATV-mounted ladders, or high lifts. Cones would be removed from trees, bagged, transported to cone storage facilities, stored to dry, and transported to seed extraction facilities.

Orchards would be thinned to increase the light for increased tree crown development and improved pollen flow. Thinning would also be used to remove the lower ranked clones (roguing), which would usually occur when the trees are from 10 to 15 years old. Trees would be felled, limbed, and removed, or whole-tree removed from the orchard units. Approximately 25 to 75% of the trees in an orchard unit would typically be removed during the roguing process. Thinned trees and woody debris from pruning would be disposed of by piling and burning, or chipping; or could be sold for firewood if routinely pruned from healthy trees. Some orchard units (production and preservation) would be cut and removed when trees become too large for cost-effective management. New orchard units would generally then be established on the same land.

Other orchard maintenance activities would include tree staking, tree identification tag maintenance, irrigation system maintenance, and bark scoring to improve graft compatibility.

Buffer Zone Management

The buffer zones are non-usable areas between seed orchard units that are too steep or wet for orchard units, have riparian characteristics, are vacant land areas, or are otherwise unsuitable or not planned for seed orchard unit development. These areas are not intensively managed and are maintained as pollen buffers, wildlife corridors, stream protection, riparian habitat, or similar uses. Sometimes sapling conifers of the same species as adjacent orchard unit species are removed from the buffer zones to limit pollen contamination of production orchards. Brush may sometimes also be removed from the buffer zones to reduce fire hazard and prevent encroachment into orchard units.

Facilities/Equipment Maintenance

Gravel access roads within the orchard would be maintained every three to five years by grading, rocking, rolling, and occasionally surfacing with chip seal to provide year-round access to the primary project areas of the orchard. The road maintenance work would sometimes include bar ditch cleaning and culvert maintenance. Road maintenance activities would occur on approximately one mile of road per year. New road segments might occasionally be built to provide access into newly established or new emphasis areas, but no new construction is anticipated at this time. Any future new road construction would include grading, rocking, rolling, and ditch and culvert installation.

The animal exclosure and security fence and gates around the perimeter of the orchards would receive regular maintenance, repair, and improvements.

Buildings, utilities, irrigation systems, security systems, and a variety of vehicles and equipment would receive regular maintenance, repair, and improvements.

Containerized Greenhouse Nursery Management

A small nursery complex on the Sprague orchard lands consists of a greenhouse, shadehouse, center-span production/holding house, greenhouse work building, cuttings chamber, 250-ft^2 modular cooler, two materials storage buildings, loading dock, hazardous materials storage building, and a wastewater filter/pump house and settling and storage tanks, with one acre of distribution sprinkler field. The growing houses total 19,000-ft^2, which can accommodate an average of 300,000 large container seedlings annually and a maximum of 800,000 small container seedlings.

Well water for irrigation, soluble fertilizers, and pesticides are delivered to plants through overhead, fixed, drop-riser, and moving boom irrigation systems, which are regulated to specific sections of the growing houses. The heating, cooling, and watering systems are electronically controlled and monitored for a controlled environment. Ceiling fans and heating tubes at floor level distribute propane-generated heat in both greenhouse and shadehouse buildings. The greenhouse cooling system uses large wall fans and outside air pulled through a bank of cooling cells, while roof vents and a temperature-controlled screen wall provide air movement in the shadehouse. Greenhouse lighting is available to meet special species' physiological requirements.

Metal tables on wheels allow for movement of plants to different environmental areas depending on container type, plant needs, and growing season. An IPM approach incorporates a wide variety of strategies using mechanical, biological, and occasionally chemical control options (no chemical control in past three years), which are deployed at predetermined thresholds of risk to the plants and allows greater flexibility with diverse crops.

A nursery wastewater system consists of the collection of all unused water in all growing houses in an enclosed pipeline to a filter house. The filtered water is moved to a 1,000-gallon (gal) settling tank and 5,000-gal storage tank for automated cover crop irrigation dispersal by an underground movable impulse sprinkler system. Four 60- to 80-ft deep wells above and below the wastewater distribution area are used for regular ground water quality monitoring. The three domestic and irrigation wells in the orchard are also used for monitoring ground water quality.

Most annual plant production begins with stratification and sowing of seeds in February through April, thinning and transplanting during May through July, and seedling sorting, packing into boxes, and transporting to coolers for storage before planting in December and January. Most of the work is accomplished by a BLM nursery horticulturist and local contractors.

The use of pesticides for insect and disease control in the greenhouse nursery at Sprague was addressed in a NEPA categorical exclusion (BLM 1996).

BLM routinely monitors the greenhouse nursery for a wide range of diseases and insects that are common in seedlings. Monitoring intensifies at certain times duirng the seedling production season, including at the end of the growing season as packing and shipping activities approach, with a lower threshold for treatment at that time. Observation of seedling health is also an integral part of the packing process, in which any potentially diseased seedlings are culled from the shipment. *Phytophthora lateralis* is very difficult to detect in small seedlings without destructive sampling of the roots and lower stem. Very little Port-Orford-cedar is propagated in the greenhouse nursery, and the risk of shipping/transporting infected seedlings out of the greenhouse's enclosed environment is extremely low. An infected Port-Orford-cedar tree releases spores that are transported by water or by soil attached to or moved by humans, equipment, or animals, thereby contacting and infecting other Port-Orford-cedar trees and resulting in the spread of the disease. The only water used in the greenhouse is from a groundwater well source (not surface water), and seedling container growing soil is commercially purchased and certified sterile. Management practices would be applied if necessary to prevent potential introduction of the pathogen into the orchard or nursery by soil on boots, equipment, or vehicle tires if these items had possibly been in contaminated areas. Although a new threat in Oregon, *Phytophthora ramorum* (sudden oak death) spores could possibly be transported into the greenhouse nursery facility (shadehouse or centerhouse) aerially on wind-blown rain; however, it is sometimes difficult to detect or differentiate on some species of greenhouse seedlings, and it is uncommon in a greenhouse nursery setting in its recent history. Sudden oak death has been detected in outdoor shrub and landscape plant nurseries. Few of the presently known host species of *P. ramorum* are currently propagated in the Sprague greenhouse nursery (small amounts of Douglas fir or hardwoods such as oaks and maples), so the risk of spreading the disease from the nursery is very low. BLM and contract staff will have additional instruction in disease symptoms and will monitor the disease status in the area to detect any occurrence of sudden oak death and help prevent its spread.

2.2 Integrated Pest Management in the Provolt and Sprague Seed Orchards

This section describes the principles of an IPM program and options for controlling insects, disease, vegetation, and animal pests at the seed orchards.

2.2.1 Integrated Pest Management

It is the policy of the Department of Interior, and all of its agencies including BLM, to use chemical pesticides only after considering the alternatives; and to develop, support, and adopt IPM strategies wherever practicable (DOI 1981).

The following description of IPM was condensed from information published by the IPM Institute of North America, Inc. (IPM Inc. 2002).

> IPM is an approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops, harming animals, infesting buildings or otherwise interfering with our livelihood or enjoyment of life. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels. Any action taken is designed to target the troublesome pest, and limit the impact on other organisms and the environment. Applying pesticides to crops, animals, buildings or

landscapes on a routine basis, regardless of need, is not IPM. . . . [Components of an IPM program include the following:]

- Forecasting: Weather data is consulted to predict if and when pest outbreaks will occur. Treatments can then be properly timed, preventing crop damage and saving sprays.

- Pest trapping: Traps that are attractive to insects are used so that growers can pinpoint when the pest has arrived and decide whether control is justified.

- Monitoring: Growers inspect representative areas of the fields regularly to determine whether pests are approaching a damaging level.

- Thresholds: Before treating, growers wait until pest populations reach a scientifically determined level that could cause economic damage. Until that threshold is reached, the cost of yield and quality loss will be less than the cost for control.

- Cultural controls: The pest's environment is then disrupted by turning under crop residues, sterilizing greenhouse tools, and harvesting early.

- Biological controls: It is necessary for growers to conserve the many beneficial natural enemies already at work. They import and use additional biologicals where effective.

- Chemical controls: Growers select the most effective and appropriate pesticide and properly calibrate sprayers. They then verify that weather conditions will permit good coverage without undue drift.

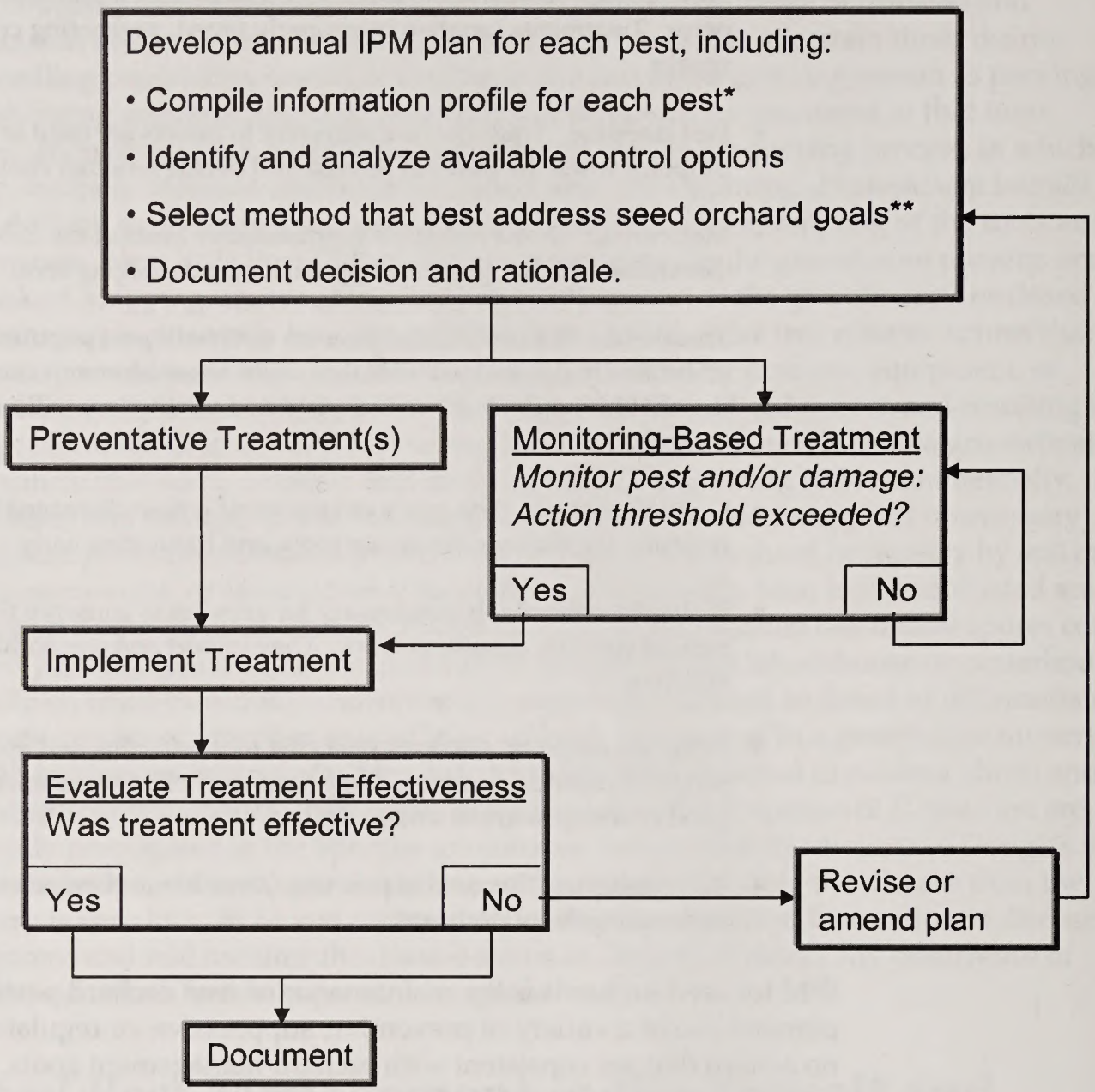
- Recordkeeping: Records of pest traps, weather and treatment are kept for use in pest management decisions.

IPM for seed orchards is the maintenance of seed orchard pests at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory methods (including no action) that are consistent with orchard management goals. Each pest management activity is the end result of a decision-making process where pest problems and their impact on hosts are considered, and control methods are analyzed for their effectiveness, as well as their impacts on economics, human health, and the environment. Deciding which particular method would be used depends on several factors. Initial questions at the seed orchard might include, "Is it really necessary to control this pest? Can we live with the damage and still have the trees survive and produce suitable amounts of seed?" If the answers are yes and no, respectively, then decisions must be made as to what method(s) of control to use. Figure 2.2-1 graphically displays the steps involved in carrying out an IPM program in BLM seed orchards.

The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed.

Research into better and more effective control methods is also an essential part of this program. The seed orchard manager would regularly review the pest management methods available for use, including new and developing technologies, to ensure that the seed orchards utilize the most effective methods of control while minimizing the potential for any adverse environmental or health impacts.

Figure 2.2-1. Seed Orchard IPM Process



*Profiles will vary in depth and included information based on threat from any particular pest; may consist of a group of files, reports, and on-line data sources.

**Goals may vary between locations and ownerships, and over time. Possible goals might include high seed production, protection of human health, protection of the environment, and cost-efficiency.

2.2.2 Pest Management Methods

There are many possible methods available to manage vegetation, insects, disease, and animal pests at Provolt and Sprague. These methods generally fall into the following categories:

- Biological controls, such as bird or bat boxes to attract insect-eaters, or encouraging predators that can control animal pests.

- Chemical herbicides, insecticides, and fungicides.

- Prescribed fire to remove vegetation.

- Cultural methods, including mechanical (tractor mowing) and manual (pruning) methods, mulch mats, and fences.

- Other methods, such as pheromone bait traps for insects.

The sections that follow outline each of these pest management methods in more detail.

2.2.2.1 Biological Control Methods

Biological pest control is the deliberate use of natural enemies such as parasites, predators, or disease organisms to reduce pest populations. Three types of biological control are in use or proposed to manage insect pests:

- Bird boxes have been installed throughout the two orchards to attract cavity-nesting birds into the orchard to nest and feed.

- Bat houses have also been placed throughout the orchards to provide roosting and breeding habitat to encourage bats, such as the big brown bat and little brown myotis, to live in the vicinity and feed on insects in the orchards.

- *B.t.*, a biological insecticide, is being considered to help reduce insect damage at the orchards.

In some special use areas of Provolt (such as the riparian restoration areas), newly planted trees, not protected with mulch mats or shade screens for sun and heat protection, rely on the natural and planted herbaceous vegetation (grass and broadleaf plants) to provide some natural shade to the trees and reduce stress and potential diseases.

Control of animal pests has been and would continue to be partially accomplished by encouraging the presence of predators which frequent the orchards. Birds of prey—such as the red-tailed hawk, American kestrel, barn owl, great horned owl, and black-shouldered kite—are seen hunting and preying on small mammals (mice, voles, gophers, ground squirrels, and rabbits) that are known to cause damage to orchard trees and facilities. To encourage the birds of prey to use the orchards, perch poles have been installed. A barn owl nest box is provided in the equipment storage barn at Provolt to encourage nesting by this species. Bobcats, coyotes, long-tailed weasels, and gray foxes are present at the orchards, sometimes with litters of young. Disturbance and activity are reduced in the areas of family sightings to encourage the species to populate, feed on rodents, and live in the orchard.

Summary: Biological Control Methods

- Insects: bird boxes to attract insect-eating birds, bat boxes to attract bats for insect control, *B.t.*

- Disease: natural and planted herbaceous vegetation left intact to provide some natural shade to seedlings, thereby reducing stress and potential diseases.

- Animal pests: perch poles for birds of prey; barn owl nest box (Provolt); predators including bobcat, coyote, long-tailed weasel, and fox are present and encouraged to populate the seed orchard grounds to aid in the control of animal pests.

2.2.2.2 Chemical Pesticide Methods

Three categories of chemical pesticides may be used at Provolt and Sprague:

- herbicides to control weeds,
- insecticides to control insects, and
- fungicides to control diseases caused by fungi.

Many private landowners and commercial operations (including those in the vicinity of the orchards), rely extensively on chemical pesticides to control unwanted pests.

For many years, the Medford seed orchards have managed pests with very limited use of chemicals: Provolt used glyphosate (Rodeo®) in 2001 and 2004 to spot-treat noxious weeds. At Sprague, very limited use has also been made of chemicals: glyphosate (Rodeo®) was used from 1999 through 2003 to spot-treat noxious weeds, and esfenvalerate was used for control of cone and seed insects annually from 1992 to 1996 in two orchard units.

Pesticides may be applied using various types of equipment. These include:

- high-pressure hydraulic sprayer,
- hydraulic sprayer with hand-held wand,
- tractor-pulled spray rig with boom,
- backpack sprayer,
- hand-held wick,
- capsule implantation, and
- broadcast spreader.

Each of these methods is described in an attachment to Appendix C.

Table 2.2-1, provided as an attachment at the end of this chapter, lists the biological and chemical pesticides that are included in the alternatives for pest management at Provolt and Sprague, including formulations, target pests, application methods, areas that could be treated, application rates, application frequency, and months when use could occur. Note that not all chemicals would be used in a given year, and some might never be used. However, their analysis in this EIS gives the seed orchard manager the option of using them in the future should a specific need arise. It is also important to note that each chemical application must first be approved by the seed orchard manager. All pesticides would be applied in compliance with all Federal and Oregon state laws, BLM regulations and policies, the pesticide label, and manufacturer recommendations.

Table 2.2-1 lists pesticides by both active ingredient (a.i.) and trade name. The *active ingredient* is the pesticidally active chemical contained in the product proposed for use, such as esfenvalerate or glyphosate. The *trade name* is the name of the formulated product that is currently expected to be used, such as Asana® XL or Roundup®. A trade name's *formulation* is described by a specific composition of active ingredient(s) and other ingredients. The formulation associated with a trade name may change over time. The chemical pesticide methods proposed in this EIS are described fully as the active ingredients listed in Table 2.2-1. The trade names provided in the table and the associated % a.i. are examples, and are current at the time of EIS publication. The trade names illustrate the formulations that may be used, but are not intended to limit the proposed IPM program to exclusive use of those formulations that are named in the table. Other formulations of the listed active ingredients may be substituted, at the same rate of application described in the table. The table presents application rates in terms of a.i. per acre or per tree, and will therefore remain applicable to any trade name or formulation of the listed active ingredients.

Summary: Chemical Pesticide Methods

- Vegetation: herbicides, including dicamba, glyphosate, hexazinone, picloram, and triclopyr.
- Insects: insecticides, including acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, horticultural oil, imidacloprid, permethrin, propargite, and Safer® soap.
- Disease: a fungicide, chlorothalonil.

2.2.2.3 Prescribed Fire

Controlled broadcast burning may be used to control one to two acres annually of vegetation along fence lines, roadsides, and irrigation ditches during the winter and early spring months. This limited control method is very dependent on fuel condition, approved fire plans, smoke management windows, and available burn crews, and is therefore not a reliable method. Pile burning is more reliable and effective as a tool to eliminate vegetation accumulated and consolidated from project work throughout the orchard over a several month period. Once or twice each year (spring or early winter), one or two piles are usually burned at each orchard by BLM fire specialists.

Pile burning of insect-infested vegetation or cones once or twice per year helps reduce insect populations by eliminating the habitat, which would allow the pupae to emerge in spring as adult insects. Pile burning of vegetation with disease infections is a sanitation method of control, which eliminates the infected material and reduces risk of spread within the orchard; burn piles are located outside of the orchard units.

Prescribed fire may be used for removing vegetation in native species beds prior to planting. High temperatures, created through the use of a propane-fueled flame wand, kill any existing herbaceous material, providing a weed-free bed for growing native plants, and quickly remove dead plant litter. Prescribed fire may also be used to remove native grass straw after seed harvest or diseased native grasses in native species beds.

Summary: Prescribed Fire

- Vegetation: control of unwanted vegetation along fence lines, road sides, and irrigation ditches; pile burning of cut/cleared vegetation.
- Insects: pile burning of insect-damaged branches and trees, burning cones from sanitation collections and insect-damaged cones.
- Disease: pile burning of infected branches and trees, burning grass straw in bed rows in the native plant gardens.

2.2.2.4 Cultural Methods, Including Manual and Mechanical Methods

Cultural control refers to the use of methods that make the habitat less suitable for pests or prevents, suppresses, or removes them. Cultural methods include both manual and mechanical control methods.

Cultural methods for vegetation include hand-pulling or using non-powered and powered hand tools and machinery to cut and clear vegetation.

- Orchards are also thinned by removing whole trees to allow remaining trees to be more thrifty and healthy. Roguing is a form of thinning process that allows trees of greater importance to remain in the orchard by removing the less desirable trees in quality or quantity. These forms of vegetation (whole tree) control reduce competition for light to tree crown surfaces, increase crown surface area for cone production, and make water and nutrients more available to the remaining trees.

- Tree crown vegetation control is done by specialized manual pruning of branches with hand pruners, handsaws, and power saws for specific objectives. In the early years of growth when the bark is thin and subject to sun and heat damage, a tree's lower stem branches are progressively removed, leaving more branches on the west and south sides of the lower stem for sun protection. As a tree grows larger and the bark becomes thicker and more resistant to sun damage, all of the lower limbs (rootstock) are removed up to the graft union so that the desirable grafted portion of the tree above the union is left. Later, as tree crowns become wider, more limbs above the union are removed to provide stem access for installation of permanent identification tags, and access for tractors and trucks traveling along the tree rows. Cultural pruning methods are also used sometimes to remove the upper portions of tree crowns (cutting the top out of the tree) for crown height management to limit the height of cone production.

- Mulch mats made of nylon or fabric mesh weave are used around newly planted seedlings in the orchard to control competing vegetation and reduce moisture loss around the tree roots. The mats are three to four feet square and are held to the ground with steel pins in each corner. The tree protrudes through a slit in the center of the mat. The mats, which are effective for many years, later break down naturally or are removed to prevent girdling of the tree. Mulch mats are also used to control vegetation around irrigation risers and other items, which can be affected by vegetation growth.

- Hand pulling, hand cutting, or hand grubbing with hand tools are methods sometimes used to remove noxious weeds after chemical control, or for some weeds before sprouting and chemical control, or in lieu of chemical control in some sensitive locations and small densities.

- Hand pulling or hand troweling, instead of power tools, is used to remove vegetation within two feet of orchard tree stems, to prevent damage to trees and to irrigation systems. In the spring, when the irrigation season is just beginning, vegetation is removed or displaced (flattened) manually at the base of trees near and around irrigation emitters to allow irrigation spray patterns to be more effective. This process is repeated in July in a more thorough and complete manner to provide effective irrigation to the trees during the critical drought months of the season.

- Mechanical control methods typically involve the use of machinery to physically cut or remove vegetation. Several mechanical methods are used at Provolt and Sprague, including the use of tractors for mowing. A variety of lawn and garden tractors and larger agricultural tractors are used with 6-ft, 12-ft, and 15-ft wide rotary mowers. Vegetation is mowed two to three times per season, generally in May/June and July/August, depending on fire risk. A late summer mowing is always necessary to provide good access for cone harvest contractors and orchard staff.

- Vegetation in areas not accessible by tractors is controlled using power string trimmers. These areas include gate openings, along some fence lines in high-risk fire areas, around buildings and other structures, along irrigation ditches, and special use areas.

- Brush cutter machines (large cutting head and articulating arm mounted on tractor) are used at times by orchard staff to cut vegetation along roadsides and other areas where it is difficult to control vegetation with other equipment. Other heavy equipment (such as a dozer or backhoe, or agricultural tractor with attached roto tiller or disk) may also be used to completely remove (rather than cut) vegetation in some development or renovation project work.

- Another method of removing accumulated vegetation from the orchard is chipping with large tub grinders and marketing the chips for electrical energy development. This method is done with cost share agreements or by contract, generally when 100 tons or more of biomass is accumulated from roguing and thinning operations in the spring.

There are many cultural methods that can help prevent insect damage:

- Tree crowns are hand-pruned and thinned of excess branches during the dormant winter season to open the tree crown to air and light, and reduce the insect habitat. All pruning work is done during the dormant season to allow the tree to heal the pruning wounds, and avoid attracting damaging insects to stressed or wounded trees, which may occur during the active growing season.

- Graft unions of new grafts and scoring wounds (a bark cutting technique to improve graft compatibility) are protected with grafting wax or spray seal to help protect against cone worm damage. This work is also done in the dormant season of late winter to allow healing of the wounds by the tree, and avoid the active flights of insects.

- Selective pruning of dead or dying branches, shaping the tree after removal of the infested terminal branches, and destroying infested branches can minimize the effects of twig weevil infestations.

- Sanitation is a cultural method used to remove insects and insect habitat from the orchard. Insect damaged branches are pruned and damaged trees are cut down and removed as soon as possible after symptoms appear.

- Cone sanitation is a cultural method of cone and seed insect control. Insect damaged cones or cones not harvested from trees for seed production are all removed from trees, collected into bags, and burned. This method of control does not protect the seed crop currently on the trees; rather it reduces insect larvae, pupae, and habitat and may reduce the following year's insect populations and damage to those cones and seeds.

- Occasionally, insect pupae that are large and noticeable, and are known to be of exotic or damaging insects, are hand picked from trees in the orchard and destroyed by orchard employees. Examples of these insects are the Cecropia moth (*Hyalophora cecropia*).

- At Sprague, occasional sawfly outbreaks occur in isolated small locations, seriously affecting small numbers of young trees (5- to 10-ft tall) in one or more sites at any one time. These trees are heavily infested with foliage-eating larvae and can be seriously injured or killed. The current method of control is to shake the trees to dislodge the larvae to the ground, followed by foot stomping to kill the larvae; many other larvae are eaten then on the ground by birds.

- Another very successful method of insect control at Sprague is to manually place cotton bags (the size of 25-lb flour sacks—1 ft wide by 2 ft long) over developing conelets in the early spring of the second year of cone development. The bags,

which are attached to the tree limbs with twist ties above the conelets, are fine mesh cotton, which allows airflow but prevents insects from attacking the cones. This preventative barrier method of insect control must be placed manually and is quite costly. However, there are many benefits to this method, including effective insect control; an efficient method of seed collection, as seeds are collected in bags as cones open naturally in the fall; and a wide window of cone harvest since the bags act as collectors.

All tree crown-pruning work and thinning/roguing work is done in the October through March dormant season to reduce the risk of stress to the trees and the possible introduction of diseases. Foliar or branch disease outbreaks on individual trees or small groups of trees can be treated by hand or mechanical pruning and tree removal, when necessary. Cankers formed on branches can be removed with specialized pruning techniques to sanitize and isolate the infections. The pruning work is a fairly successful direct control measure if the infections are noticed and treated promptly. The pruned material is removed from the orchard and destroyed, normally by burning.

Sun scald and tree basal heat damage, especially of small or newly planted trees, is a serious risk during much of the year in southern Oregon. Heat lesions or stem splitting of bark results in open wounds, dead tissue, and stress, which increase the opportunity for disease infections. To control or reduce these disease conditions, mesh shade screens on wire frames are placed by hand on the south and west sides of small and newly planted trees. Older trees with exposed and thin bark are hand painted with an elastic white paint on the south and west sides of the tree stem to reflect the sun rays and insulate from extreme heat.

For animal pests, particularly for such animals as gophers, skunks, porcupines, wild or runaway dogs and feral cats, live trapping and relocation or kill trapping are possible alternatives.

Control of western gray squirrels is the most serious issue in orchard animal control at Sprague. The squirrel populations are currently reduced by the use of a pellet gun by orchard employees and a permit issued annually by the Oregon Department of Fish and Wildlife (ODFW). In addition, the harvested cones in the fall of each year are protected from gray and ground squirrels while being stored in the cone storage building at Sprague. The entire perimeter of the pole barn building is screened with chicken wire. The wire also extends underground two feet for protection against tunneling. Finally, beavers, another animal pest at Sprague, are live-trapped, or may be encouraged to move out of the orchard by lowering the lake's water level for several days.

For animal pests, deer and elk exclusion fencing can be used to reduce browsing damage. The developed orchard lands at Sprague are protected with a seven-foot high chain link fence with barbed wire at the top, for a big game exclosure. The orchard lands at Provolt are protected with an eight-foot high woven wire fence as a big game exclosure.

Rodents such as mice and voles, California ground squirrel, rabbits, and other animals require cover habitat in tall grass, under low tree limbs, or in thick edge areas. To help reduce habitat in the orchard and possible damage to facilities from the animals, the tree limbs in the orchard are pruned up at the base, and unwanted vegetation, especially blackberries, are removed at the edges of the orchard.

The orchard gates are often open during the day to provide access for employees, contractors, and other visitors for project work. Occasionally deer will travel through the gates into the orchard and back out again but sometimes will stay inside and require manual removal, by walking (herding) the animals through the gates.

Tractor mowing of cover crop vegetation has many benefits. Tall grass provides cover habitat for animals so grass is kept short throughout the orchard to reduce this habitat.

Summary: Cultural Control Methods

- Vegetation: hand-pulling; pruning; thinning; hand tools to cut and grub; tractors with various blade attachments for mowing; gasoline-powered string trimmers; brush cutter machine mounted on tractor; chainsaw for cutting up thinned, rogued, dead/dying orchard trees; power pruner; wood chipper; chipping with large tub grinders and marketing the chips for energy development; mulch mats.

- Insects: pruning, thinning, shaping, use of grafting wax or spray seal on tree wounds, sanitation of damaged branches and trees, sanitation of insect-damaged cones and cones not harvested for seed production, hand-picking large and noticeable insect pupae.

- Disease: pruning, power saws to cut infected or dead trees, removal of diseased plants from the native plant gardens using a tractor and roto tiller, mesh shade screens to protect seedlings from heat damage, hand-painting older trees with exposed and thin bark to reflect the sun's rays and insulate from extreme heat.

- Animal pests: walking (herding) stray deer toward and out the gates; pruning tree limbs up at the base of the trees; removing unwanted vegetation, and mowing cover crop vegetation that would provide cover for small mammals; live trapping; lowering the lake's water level for several days to cause beavers to move out (Sprague); pellet gun to reduce western gray squirrel population (Sprague); screening buildings and under buildings to act as a barrier against western gray squirrel, skunks, and other animals (Sprague).

2.2.2.5 Other Control Methods

Pheromone bait traps can attract and capture damaging insects.

Annual soil and foliar analyses results are used to develop fertilization plans to adjust soil pH levels and provide the necessary nutrients for adjustment toward zero deficiency. Soil moisture is monitored to develop and adjust irrigation schedules during the season to provide sufficient water for plant functions. These actions help orchard trees maintain the health and vigor necessary to resist adverse effects from insects and disease. Application details for fertilizers are included in Table 2.2-1.

Summary: Other Methods

- Insects: pheromone bait traps.

- Fertilization to promote overall tree health, cone production, and disease resistance.

2.3 Alternatives

2.3.1 General Description and Features Common to All Alternatives

Four alternatives based on the pest management approaches described in Section 2.2.2 were identified and evaluated by BLM to address the need for a pest management program at the Medford District seed orchards, as follows:

- Alternative A—Maximum Production IPM
- Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)
- Alternative C—Non-Pesticide Pest Management
- Alternative D—No Action: Continue Current Management Approach

There are several features common to all alternatives. Pest management methods that are common to all alternatives are non-pesticide biological methods, cultural methods, prescribed burning, and other control methods. Additional activities common to all alternatives include orchard management activities unrelated to pest management (see Section 2.1.2) and protection measures that would be associated with a given pest control method under any alternative in which it is included. These protection measures are described in the following paragraphs.

Protection measures are intended to ensure the proper and safe application of pesticides at the Provolt and Sprague Seed Orchards. FIFRA requires pesticide manufacturers to register their chemicals with EPA, and list the allowable uses, application rates, and special restrictions on each pesticide's label. The pesticides considered for use at Provolt and Sprague are all registered under FIFRA. Application operations would comply with the label rates, uses, and handling instructions, in accordance with Federal law. In addition, the following procedures would be designed and implemented by the seed orchards, and routinely observed in pesticide applications. If output from the monitoring plan (see Appendix B) indicates that more protection is needed, these protection measures may be altered over the life of this IPM program to provide more (but not less) protection to workers, the public, the environment, and ecological resources:

Worker Protection Measures

- Pesticide treatments would frequently be completed under contract by licensed pesticide applicators. BLM would administer the contracts for compliance.

- A Job Hazard Analysis for pesticide applications would be developed, providing a detailed description of the jobs and associated risks involved with pesticide use and application, and identifying requirements for personal safety equipment, training, and certification to perform specific tasks.

- The seed orchards would develop a Pesticide Safety Plan, which would include safe handling and application procedures and a Spill Prevention Plan.

- Pesticide applications would be conducted in compliance with all aspects of EPA's Worker Protection Standard under FIFRA, including protection during applications, restricted entry intervals, personal protective equipment, notification of workers, decontamination supplies, emergency assistance, pesticide safety training and safety posters, and access to labeling and site-specific information.

- All workers involved in pesticide applications would be required to participate in a pesticide exposure monitoring program. Testing for cholinesterase inhibition would be conducted on BLM employees applying organophosphates. Also, workers with

declared hypersensitivity or who display symptoms of hypersensitivity to pesticides would not be assigned to application projects.

- Material safety data sheets would be posted at storage facilities and made available to workers.
- Appropriate protective clothing would be worn by all workers, as required by each pesticide's label.
- All applicators would be trained and licensed; this training would be confirmed by the seed orchard manager.
- For all application methods except spot treatments using hand-held application equipment, treated areas would not be re-entered until sprays have dried or until the stated label re-entry period has been met, unless protective clothing is worn and early re-entry is permitted by the label.

Public, Environmental, and Ecological Protection Measures

- Warning signs would be posted to discourage entry into treated areas.
- Pesticides would be applied within the parameters of prescribed environmental conditions stated on the label.
- No spraying would occur if snow or ice covers the target foliage.
- Factors such as relative humidity, wind speed, and air temperature would be considered to determine the timing of applications that would minimize the potential for off-target drift.
- Pesticides shall not be applied under the following weather and soil conditions unless the product label specifically recommends otherwise. (1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. (2) In areas with standing water and saturated soils. (3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.
- Equipment used for pesticide transport, mixing, and application would be properly maintained to avoid leaking pesticides into water or soil.
- Maintenance and calibration of spray equipment will occur at least annually to ensure proper application rates.
- Pesticides would be mixed and equipment cleaned in areas protected (e.g., paved and bermed, or on a portable bermed mixing pad) from the potential for runoff to surface waters or leaching to groundwater in the case of a spill.
- Chemical weed control within 20 feet of perennial and non-perennial streams with flowing water at the time of application would be limited to spot hand applications. In stream reaches where foliar applications of Rodeo® are used to treat knotweed growing in dry portions of the stream channel below the ordinary high water elevation, application is limited to the dry portions of the stream channel in the preferred in-water work period, in accordance with ODFW guidance.
- Fertilizar applications would be timed, to the extent predictable by weather forecasts, to not coincide or closely precede a storm event that could result in substantial runoff.
- Silt catchments barriers, such as bio-bags, will be installed across all ephemeral drainages located adjacent to or inside treatment units during periods when overland flow may occur following pesticide application. The function of these barriers will be to catch organics and sediment leaving the treatment area.

- Drift cards would be used to indicate when spray is heading toward a riparian zone, and spraying would cease if this danger seems likely.

- When spraying trees within two tree rows from the edge of treatment unit perimeters, spraying will be done by directing the nozzle towards the center of the treatment unit, minimizing the chance for drift outside the designated treatment areas.

- Temperatures would be monitored carefully.

- If possible, spraying would be conducted during the early morning or late evening, allowing foliage to dry before pollinators become active.

- Orchard fields would be mowed prior to insecticide applications, to remove floral components on ground cover that would attract pollinators, such as bees (if pollinators are active).

- Two special status[1] plant species are known to occur at Sprague in riparian stream buffers, dry drainage ditches, and other low, seasonably wet spots:

- Bureau sensitive species: slender meadow-foam (*Limnanthes gracilis* ssp. *gracilis*); and

- Bureau sensitive species: coral-seeded allocarya (*Plagiobothrys figuratus* var. *corallicarpa*).

- Herbicide-free buffer zones would be implemented for the protection of each of these special status plant species. Alternatively, mechanical control of nearby weeds could be accomplished through mowing.

- The monitoring program, detailed in Appendix B to this EIS, would be implemented as described for chemical pesticide applications.

- No carrier other than water would be used to mix (dilute) the pesticide products for application. In some cases, surfactants or adjuvants may be added to application mixtures of pesticides to improve their effectiveness or minimize handling and application problems. The seed orchards will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000a). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical would be evaluated before a use determination is made. No additional adjuvents will be added to Rodeo (glyphosate).

- No more than one application of picloram will be made on an area in any given year to reduce the potential for picloram accumulation in the soil.

- Permethrin aand esfenvalerate will not be used in the same year.

- At Sprague, only one application method for permethrin or esfenvalerate will be used in a year.

- At Provolt, no chemical pesticides would be applied to road or ditch surfaces that directly contribute to stream channel flow, nor to fencelines within 50 feet on either side of stream channels.

- Fertilizer will not be applied within 50 feet of any stream, wetland or other waterbody.

- Fertilizer loading areas shall be at least 100 feet from perennial streams.

[1] Special status species are species which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the Endangered Species Act; those listed by a state in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

- Design prescribed burns to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to restore riparian ground cover and vegetation. Ensure that all vehicles, including emergency equipment, are not operated, maintained, or stored next to any stream, water body or wetland. Ensure that all vehicles, including emergency equipment, are not fueled within 150 feet on any waterbody. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.

2.3.2 Alternative A—Maximum Production IPM

Under this alternative, the primary goal is the maximum production of seeds and plants with a very low level of acceptable losses. The seed orchard manager for Provolt and Sprague would have all the methods of pest management listed in Section 2.2.2 available for use, including all identified biological, chemical, prescribed fire, cultural, and other pest control methods. An effective IPM strategy for all orchard pests would be used under this alternative, including monitoring pest levels and treating if action thresholds are exceeded. However, the primary management objective, which would be reflected in the annual IPM plan (see Figure 2.2-1), would be to maximize seed production for annual BLM and cooperator seed needs by aggressively controlling cone and seed insects and other limiting factors. The most effective insect control measures would be implemented, to maximize seed yield and reduce damage to the seed crops with low acceptable seed losses, emphasizing production above other less-effective control methods and considerations, with a low threshold for initiating treatment.

2.3.3 Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B is BLM's preferred alternative. An effective IPM strategy for all orchard pests would be used under this alternative, including monitoring pest levels and treating if action thresholds are exceeded.

Under this alternative, the seed orchard manager would have access to the full list of pest management methods identified in Alternative A, with the exceptions listed below. These limitations were identified by reviewing the results of the quantitative risk assessment (summarized in Appendix C), considering the scoping comments, and responding to recommendations made by district interdisciplinary team members. In addition, some chemicals would likely not be used or seldom used at both seed orchards because of ecological protection limitations and considerations. These chemicals include acephate, chlorpyrifos, diazinon, propargite, hexazinone, and picloram.

These limitations, listed below, address each risk identified during the risk assessment for Alternative A (summarized in Table 4.6-2 for human health and Table 4.7-2 for wildlife and aquatic species). Each quantitative limitation was calculated by varying the application scenario parameters in the model spreadsheet until the risk was lowered to the acceptable level. Parameters that were varied were those that the seed orchard manager can limit when approving the application, such as application rate, frequency, length of time to re-entry, total area or number of trees treated, and distance from area assumed to receive drift in the risk assessment scenario. The resulting risks correspond in each case to the negligible risk levels for human health, terrestrial wildlife, and aquatic species (see Section 4.6.1 for human health risk methodology and Section 4.7.1 for non-target species risk methodology).

Limitations to protect worker health:

- An individual worker would not mix, load, and apply more than 3.75 lb a.i. of diazinon using a high-pressure hydraulic sprayer in any one day.

- An individual worker would not mix, load, and apply more than 9 lb a.i. of diazinon using a hydraulic sprayer with a hand-held wand in any one day.

- A closed mixing system would be used to prepare dimethoate for application by hydraulic sprayer with hand-held wand.
- Dimethoate would not be applied using a backpack sprayer.
- No more than 0.3 lb a.i. of permethrin would be applied by any individual worker using a backpack sprayer in one day.
- No more than 0.7 lb a.i. of propargite would be applied by any individual worker using a backpack sprayer in one day.
- No more than 0.61 lb a.i. of dicamba would be applied by any individual worker using a backpack sprayer in one day.
- No more than 6.7 lb a.i. hexazinone would be applied by any individual worker using a backpack sprayer in one day.
- Irrigation system maintenance personnel would not work in an orchard unit treated with chlorpyrifos at the maximum label application of 2 lb a.i. per acre (estimated 0.04 lb a.i. per tree) until at least 12 days post-application.
- Irrigation system maintenance personnel would not work in an orchard unit treated with diazinon at the maximum label application of 0.075 lb a.i. per tree until at least 26 days post-application.

Limitations in response to scoping concerns:

- Chemical herbicides would not be used to control blackberries along the common boundary between the Provolt Seed Orchard and the Provolt Grange.
- At Provolt, insecticides for cone and seed insect control would not be applied using a high-pressure hydraulic sprayer to the two rows of trees nearest and directly adjacent to any public or private road or private property, to provide a buffer from drift. This would apply to the north and east sides of unit 6; the east sides of units 8, 10, and 12; the south sides of units 1, 2, 3, 14 and 17; the west sides of units 7, 9, 11, 16, and 17; the north sides of units 1 and 4; and the south and west sides of unit 15.
- At Sprague, insecticides for cone and seed insect control would not be applied using a high-pressure hydraulic sprayer to the two rows of trees nearest and directly adjacent to any public or private road, private property, or railroad right-of-way, to provide a buffer from drift. This would apply to the west side of unit 42, the north sides of units 44 and 45, the west and south sides of unit 52, the west and north sides of unit 53, the north and east sides of unit 54, and the southeast side of ponderosa pine unit 44.

Limitations to protect ecological resources:

- Chlorpyrifos would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit when a high-pressure hydraulic sprayer is used, or within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or unit edge when applied with a hydraulic sprayer with hand-held wand (these are the distances associated with no drift from the respective application methods).[2] It would not be applied to more than 166 trees at a rate of 0.02 lb a.i. per tree (nor any

[2] To protect reptile and bird species.
[3] To protect the black-capped chickadee.

combination of number of trees and application rate that is more than 3.32 lb a.i. total applied) in any 12-acre area within a 14-day period.[3]

- Diazinon would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit when a high-pressure hydraulic sprayer is used, or within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or unit edge when applied with a hydraulic sprayer with hand-held wand (these are the distances associated with no drift from the respective application methods).[4] It would not be applied to more than one tree per acre within an 11-day period.[5]

- Dimethoate would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods).[6] It would not be applied to more than three trees at a rate of 0.13 lb a.i. per tree (nor any combination of trees and application rate that is more than 0.39 lb a.i. total applied) in any one-acre area within a seven-day period.[7]

- At Provolt, to decrease the potential for drift or runoff to surface water, esfenvalerate would not be applied to trees in the two rows of orchard trees nearest and directly adjacent to Williams Creek in units adjacent to the creek: units 1, 5, 7, 9, and 17; and the two rows of trees nearest the two irrigation ditches in units 5, 7, 12, 14, 15, and 16. These trees would then act as an additional shield against drift toward the surface water, as well as increase the buffer against overland runoff containing pesticide residues by as much as 200% in some areas.

- At Provolt, insecticides would not be applied using a high-pressure hydraulic sprayer to the two rows of trees nearest and directly adjacent to any open water, to provide a buffer from drift or runoff. (At Sprague, the waterways are intermittent and the existing natural vegetation buffer areas are high, thick, and wide, so no additional restriction is specified for that seed orchard.)

- Application buffers. Application methods will be restricted by zones as shown in Tables 2.3-1a and 2.3-1b. Zone widths refer distances from any intermittent or perennial stream or waterbody with flowing water, measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration zone, or the edge of any associated wetland, whichever is greater. These buffer widths shall not be decreased over the five-year term of the NOAA-Fisheries biological opinion, which expires on February 9, 2010.

- The terms and conditions specified by NOAA Fisheries during the ESA consultation process are incorporated as additional limitations into Alternative B, the proposed action, and are presented in full in the next subsection.

[4] To protect reptile and bird species.
[5] To protect the black-capped chickadee and western bluebird.
[6] To protect reptile and bird species.
[7] To protect all terrestrial species.

Table 2.3-1a Minimum Pesticide No-Spray Buffers at Provolt Seed Orchard[1]

Chemical	Application Method	Minimum Stream Buffer (ft)
B.t. Chlorothalonil Chlorpyrifos Diazinon Esfenvalerate Horticultural oil Permethrin Potassium salts of fatty acids Propargite	High-pressure hydraulic sprayer	90
Dicamba Glyphosate Hexazinone Picloram Triclopyr	Tractor-pulled spray rig with boom	40
B.t. Chlorothalonil Chlorpyrifos Diazinon Dicamba Dimethoate Esfenvalerate Glyphosate Hexazinone Permethrin Picloram Potassium salts of fatty acids Propargite Triclopyr	Hydraulic sprayer with handheld wand	40
Dicamba Dimethoate Esfenvalerate Glyphosate Hexazinone Permethrin Picloram Potassium salts of fatty acids Propargite Triclopyr	Backpack sprayer	40
Dicamba Glyphosate (for invasive weeds only)	Hand-held wick, Backpack sprayer	20
Glyphosate (Rodeo®) ñ for invasive weeds only	Hand-held wick	<20
Acephate Imidacloprid	Capsule implantation	40
Fertilizers	Broadcast spreader	50

[1] These buffer zones may be adjusted if drift monitoring results are obtained that demonstrate that either a reduced buffer would not introduce chemicals into the waterways or that a wider buffer is required. However, buffer widths will not be decreased during the term of the present NOAA-Fisheries opinion, which expires on February 9, 2010. After February 9, 2010, changes to buffer widths would be subject to further consultation with NOAA-Fisheries.

Table 2.3-1b Minimum Pesticide No-Spray Buffers at Sprague Seed Orchard[1]

Chemical	Application Method	Minimum Stream Buffer (ft)
B.t. Chlorothalonil Chlorpyrifos Diazinon Esfenvalerate Horticultural Oil Permethrin Potassium salts of fatty acids Propargite	High-pressure hydraulic sprayer	90
Dicamba Glyphosate Triclopyr	Tractor-pulled spray rig with boom	90
Acephate *B.t.* Chlorpyrifos Diazinon Dicamba Dimethoate Esfenvalerate Glyphosate Hexazinone Horticultural oil Permethrin Picloram Potassium salts of fatty acids Propargite Triclopyr	Hydraulic sprayer with handheld wand	50
Dicamba Dimethoate Esfenvalerate Glyphosate Hexazinone Horticultural Oil Permethrin Picloram Potassium salts of fatty acids Propargite Triclopyr	Backpack sprayer	50
Glyphosate ñ for invasive weeds only	Hand-held wick, Backpack sprayer	<20
Acephate Imidacloprid	Capsule implantation	50
Fertilizers	Broadcast spreader	50

[1] These buffer zones may be adjusted if drift monitoring results are obtained that demonstrate that either a reduced buffer would not introduce chemicals into the waterways or that a wider buffer is required. However, buffer widths will not be decreased during the term of the present NOAA-Fisheries opinion, which expires on February 9, 2010. After February 9, 2010, changes to buffer widths would be subject to further consultation with NOAA-Fisheries.

Provolt - Terms and conditions:

Terms and conditions were specified by NOAA Fisheries during ESA consultation to implement reasonable and prudent measures. These are included in the limitations incorporated into Alternative B, the proposed action, and are provided, verbatim, below.

Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The BLM has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the BLM fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions.

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of listed species resulting from completion of the proposed action.

The BLM Shall:

1. Minimize incidental take by ensuring that orchard pests are managed using IPM techniques that use treatment thresholds and minimize the need for pesticide application.
2. Minimize incidental take from pesticide applications by choosing pesticide formulas, timing, place, and manner of pesticide use to minimize the likelihood of delivery to riparian and aquatic systems.
3. Minimize incidental take from fertilizer application by ensuring that fertilizer is applied in a time, place and manner that minimizes the likelihood of delivery to surface and groundwater.
4. Ensure completion of an annual comprehensive monitoring and operations reporting program to confirm this Opinion is meeting its objective of minimizing take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BLM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary and, in relevant part, apply equally to proposed actions in all categories of activity.

1. To implement Reasonable and Prudent Measure #1 (integrated pest management) the BLM shall:
   a. Treatment Thresholds. Ensure that no action to suppress insect pests will be taken unless pest monitoring show that one or more pests have reached a threshold at which losses in seed yield and quality exceed the economic and environmental cost of treatment. No pesticide will be applied on a routine basis, without regard for treatment thresholds based on pest populations.
   b. Prescribed Burning. When prescribed burning will be used as a pest control, the following conditions will apply.
      i. Design the prescribed burn to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function.
      ii. Ensure that all vehicles, including emergency equipment, are not operated, maintained and stored next to any stream, waterbody or wetland. Equipment

shall not disturb native riparian vegetation.

iii. Ensure that all vehicles, including emergency equipment, are not fueled within 150 feet of any waterbody.

iv. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to restore riparian ground cover and vegetation.

v. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.

c. Each supervisor engaged in IPM activities must be informed of the following requirement:

NOTICE: If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NMFS Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

2. To implement Reasonable and Prudent Measure #2 (use of pesticides), the BLM shall ensure that:

a. Spill Prevention Plan. Prepare and carry out a spill prevention plan to prevent contamination from spill of pesticides and other hazardous materials. The plan will contain the pertinent elements listed below, meet requirements of all applicable laws and regulations, and must be available for inspection on request by NMFS.

i. The name and address of the party(s) responsible for accomplishment of the spill prevention plan.

ii. A description of any regulated pesticide and other hazardous materials that will be used as part of the IPM Plan.

iii. Training and certification for those who will be involved with pesticide transportation, storage, use, disposal, record keeping, monitoring, and emergency response

iv. Practices to prevent spills associated with mixing sites (i.e. containment), critical areas where spills are likely to occur, and environmental restrictions.

v. Spill containment and notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available on the site, proposed methods for disposal of spilled materials.

vi. Identify specific routes of the equipment, load limits for equipment, allowable speeds on the routes, mixing site limits in quantities, chemical types, or spill potential.

b. Choice of pesticide. Choose pesticides and additives as follows:

i. When pesticides are required, the BLM will choose the pesticide that is least toxic to fish while meeting IPM pest control objectives, and accounting for human health concerns.

ii. No carrier other than water will be used to mix (dilute) the pesticide products for application.

iii. No surfactant or adjuvant that contains ingredients included on EPA's List 1 or 2 for toxicological concern or that has a high priority for testing (EPA 2000a) may be used, unless otherwise approved in writing by NMFS.

iv. Only one application of picloram may be made on an area in any given year to reduce the potential for picloram accumulation in the soil.

v. No additional adjuvants may be added to Rodeo®, including but not limited to 'x-77.'

c. Timing of pesticide application. Time pesticide applications as follows:
   i. Prioritize applications for mornings or evenings when pollinators are not active (as seasonally applicable) in accordance with the best overall weather period.
   ii. Weather. Pesticides will **not** be applied under the following weather and soil conditions unless the product label specifically recommends otherwise.
      (1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. These methods shall be documented and included in the annual monitoring report.
      (2) In areas with standing water, saturated soils, snow or ice.
      (3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.
      (4) In wind that exceeds 6 miles per hour or blows toward flowing streams.

d. Areas of pesticide application.
   i. Application buffers. Application methods will be restricted by zones as follows. Zone widths refer distances from any intermittent or perennial stream or waterbody with flowing water, measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration zone, or the edge of any associated wetland, whichever is greater. These buffer widths shall not be decreased over the five-year term of this Opinion.
      (1) **<20 Feet.** Cultural methods and hand-held wicks using the Rodeo® formulation of glyphosate. Only small amounts of the product as required to treat the immediate application site may be brought into this zone. In stream reaches where foliar applications of Rodeo® are used to treat knotweed growing in dry portions of the stream channel below the ordinary high water elevation, application will be limited to the dry portions of the stream channel in the preferred in-water work period, in accordance ODFW guidance.
      (2) **>20 Feet.** Cultural methods only, although hand-held wicks and backpack sprayers may be used to control plants designated as noxious weeds in Oregon, as defeined in ORS 603-52-1200, that cannot be effectively controlled using cultural methods.
      (4) **>40 Feet.** All of the above, and hydraulic sprayers with handheld wands, capsule implants, and tractor pulled spray rigs with booms
      (5) **>90 Feet.** All of the above, and high pressure hydraulic sprayer.
   ii. Do not apply pesticides to road or ditch surfaces that directly contribute to stream channel flow, nor to fence-lines within 50 feet on either side of stream channels.
   iii. Install silt catchments barriers, such as bio-bags, across all ephemeral drainages beside or inside treatment units when overland flow may occur following pesticide application.

e. Method of pesticide application.
   i. Mow or graze orchard fields before insecticide applications to remove floral components or ground cover that attract pollinators (as seasonally applicable and practicable).
   ii. No pesticide may be applied on a routine basis, without regard for treatment thresholds based on pest populations.

3. To implement Reasonable and Prudent Measure #3 (use of fertilizers), the BLM shall ensure that:

   a. Fertilizer will not be applied within 50 feet of any stream, wetland or other waterbody.

b. Fertilizer will be applied at agronomic rates.
c. Fertilizer loading (pertaining to application equipment) areas shall be at least 100 feet from perennial streams.

4. To implement Reasonable and Prudent Measure #4 (monitoring and reporting), the BLM shall ensure that:

a. Annual monitoring report. All water quality monitoring information associated with application of the Provolt Seed Orchard IPM program shall be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' shall include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, shall be contained in an Annual Provolt Seed Orchard Monitoring Report. This report shall be available to the public and regulatory agencies on November 15 of each year and be on file at the Provolt seed orchard. This report shall include the following information:
   i. Project Identification.
      (1) BLM contact person.
      (2) Pesticide project manager.
      (3) Starting and ending dates for work completed.
   ii. IPM Documentation.
      (1) Description of how treatments were based on weather and pest monitoring.
      (2) A description of the biological and cultural pest controls used before pesticides were applied, or the reasons that biological and cultural controls were not used. Note that this provision is applicable to initial decisions to apply pesticides in response to pest population levels, not each individual application, and shall be documented within the annual monitoring report.
   iii. Pesticide Use History.
      (1) Type of chemical applied.
      (2) Date of application.
      (3) Buffers present.
      (4) Method of pesticide application.
      (5) Total area treated.
      (6) Amount of pesticide applied.
      (7) Precipitation for the three days preceding and following application.
      (8) Wind direction and speed, relative humidity, air temperature at time of application.
      (9) Location used for mixing and loading and notes regarding whether any leakage or spills occurred.
   iv. Effectiveness Monitoring.
      (1) Orchard units or treatment areas directly beside open water (within 100 feet) shall require drift cards be placed at a maximum of 100foot intervals along the edge of Provolt's unit before the application (for high-pressure hydraulic sprayer applications).
      (2) If open canopy occurs in the waterway buffer, drift cards shall be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Any applications shall cease if there is any indication that there is off-target delivery occurring.
   v. Surface Water Monitoring to Detect Drift.
      (1) For high-pressure hydraulic sprayer applications of chemicals, water samples shall be collected before and after spray application that include representative '15 minute' and 24-hour (composite)' post treatment water samples.
      (2) Surface water samples are collected within the project area, also, where appropriate, collect water samples concurrently where flowing water enters the project area to facilitate a baseline/cumulative concentration analysis.

Surface drift monitoring shall occur for the following compounds that are applied using the specific methodologies.

<table>
<tr><th>Application Method</th><th>Compound</th><th>Surface Water Drift Monitoring</th><th>Sites for Surface Water Drift Sampling</th><th>Sites for SPMD Placement</th></tr>
<tr><td rowspan="5">High pressure hydraulic sprayer</td><td rowspan="5">Esfenvalerate
Chlorpyrifos
Permethrin
Diazinon
Dimethoate
Propargite
Chlorothalonil</td><td rowspan="5">A representative stream or streams will be sampled and tested for each application</td><td>Beside Williams Creek.

Units 1, 5, 7, 9a, 17</td><td>Williams Creek above 9a and below 1 and 17 for 1, 5, 7, 9a</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Beside Irrigation ditches 1, 5, 7, 9b, 12, 14, 15, 16</td><td rowspan="3">Bridgeport Ditch NW corner of 7 and SE corner of 14 for 5, 7, 9b, 12, 14

Laurel Hill Ditch NW corner of 15 and above 1 for 1, 15, 16.</td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td>Hydraulic sprayer w/ handheld wand</td><td>Esfenvalerate</td><td>Surface water sampling and testing for each application within 300 feet of surface water</td><td colspan="2" rowspan="2">Same as above</td></tr>
<tr><td>Backpack Sprayer - Hand-held wand</td><td>Esfenvalerate</td><td>Surface water sampling and testing for each application within 100 feet of surface water</td></tr>
</table>

Note: For Orchard Unit numbers referenced above, see page76-78of the Provolt Biological Assessment.

vi. Cumulative Concentrations Runoff.

(1) Stormflow with the highest potential for chemical presence shall be sampled and, during these flow events, samples shall be composited according to the rise and fall of the hydrograph.

(2) SPMDs shall be deployed to sample initial winter storms and spring storm periods after pesticide application.

(3) The SPMDs shall be tested for those pesticides that were applied that can be accurately sequestered.

(4) SPMDs will be strategically deployed in timeframes that are representive of potential exposure scenarios, such as runoff from significant rain events and or drift during application. SPMDs shall be deployed for approximately 30 days, though smaller time increments are encouraged because they are more sensitive to pulses of pesticides.

Provolt monitoring locations for runoff and SPMD placement shall be at the following sites.

Sites related to surface runoff	Sites related to SPMD placement	Sites related to tile monitoring
Section 23; (site 9c) Ph-2, beside I-33 I-33 B-51 P-32	Section 23, above and below the SPMD B-51 I-33 Ph-2 beside I-33	 B-12 B-14 (tile site 3) I-33 I-10 (tile site 2) Control (tile site 1)
Section 23; (site 11a) I-12 I-11 I-33 Ph-2 I-10	Section 13 SPMD: Stream 5 and 2. B-30, B-11, B-50, B-15, B-12, B-14	

Note: For Orchard Unit numbers referenced above, see page 85 and 86 of the Provolt Biological Assessment.

vii. Validation Monitoring. For select sites, monitoring shall be used to validate the water quality modeling predictions presented in the EIS and BA.
  (1) Concentrations shall be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.
  (2) If detectable concentrations are found, stream concentrations shall also be compared to model results using actual application information, field-specific data, and continuous climate record. These data shall provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.

viii. Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, shall be immediately evaluated to determine if water sampling is desirable and necessary. If the spill occurs in an area that is reasonably certain to deliver to surface waters, either immediately, or on the next precipitation event, sampling shall occur, as appropriate.
  (1) Water samples shall be collected in a sufficient number and at surface water and groundwater locations that shall allow characterization of impacts and effective remediation methods. Depending on ODEQ Monitoring Hazardous Substances Remediation Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil.

ix. Groundwater Monitoring. The domestic well at Provolt shall be monitored for groundwater contamination. These samples shall occur annually, and normally be collected in late summer and handled according to state-certified laboratory instructions.
  (1) Groundwater monitoring wells associated with the greenhouse effluent field shall be monitored. Water quality sampling shall be conducted when risks are highest for irrigation water to potentially reach the local groundwater table. If 'point in time' samples are found to have detectible levels of the pesticide, SPMDs shall also be deployed in selected wells to allow a more quantitative determination of concentration over time.
  (2) Notification of Discharge. If a surface water discharge occurs, the BLM shall notify NMFS within 10 business days of detection. Notification shall include the type, location, and concentration of the discharge.

x. Circumstances that would trigger reinitiation:
   (1) More than one discharge per zone, as defined in this Opinion, between the 'low trigger' and 'high trigger'; values (within any one year). Note that discharges below the low trigger value are not applicable to this total.
   (2) A discharge within any one year above the 'high trigger' value.
   (3) For compounds with a common mode of action (i.e. pyrethroids and organophosphates), if the sum total of the toxic units is ≥0.05 (equivalent to 1/20th of the standardized LC50s) it will be counted as a 'low trigger' exceedence. If the sum total of the toxic units is > 0.5 (equivalent to 1/2 of the standardized LC50s) it will be counted as a 'high trigger' exceedence. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column). The toxic units for each class, pyrethroids, and organophosphates, will be calculated as outlined within this Opinion. Only one 'low trigger' exceedence will be counted if there is a toxic unit 'low trigger' exceedence for a particular chemical family that contains a 'low trigger' exceedence of an individual compound within that same chemical family.
   (4) To account for the synergistic action of pyrethroids and organophosphates, as described within this Opinion, an exceedence of a 'low trigger' of both a pyrethroid and an organophosphate (either individually or as a sum total of family toxic units) will be considered the equivalent of exceeding a high trigger. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column), and includes SPMD data.
   (5) Upon any SPMD detection, the data shall be used to provide a 24-hour average waterborne contaminant concentration for the chemicals that were applied and can be sequestered. To reflect the margin of error within the SPMD methodology, a two-fold safety factor (Huckins 2004) shall be applied to the back calculated 24-hour average concentration (multiply the value by two). The corrected 24-hour concentration shall then be treated as a discharge within the final monitoring plan and the same circumstances apply for reinitiation.
   (6) An annual review of SPMD data collection, data use, and sampling methodology may occur. In the event of a detection, factors leading to the resultant discharge concentration shall be reviewed.

c. Annual Operation Report. The Annual Operation Report will be submitted to NMFS by December 1st, and include the following information (NMFS will review the Annual Operation Report within 30 business days of its receipt, note that the annual operations plan for 2005 only needs to include data specified within number (5)):
   i. The results of the previous year monitoring program. If a discharge occurred during the previous year, possible causes of the discharge shall be explored, as well as future mitigation steps to prevent like discharges in the future.
   ii. A data review of the pesticides that are proposed for use, or may be used, at Provolt in the following year. The review shall include:
      (1) New scientific data regarding non-target fish species effects or environmental fate.
      (2) Changes to EPA-approved labels (ESA-approved and other).
      (3) A review of legal findings relevant to the use of pesticides.
      (4) A plan for proposed pesticide applications for the following year, including, to the extent possible, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored.
      (5) Any proposed changes to the IPM, including new limitations, protection measures, or mitigation measures as part of an adaptive management

approach; the use of pesticides in addition to those proposed; or other relevant information.

(6) The annual report shall be sent to:

Director, Oregon State Habitat Office NMFS
Attn: 2004/00207
525 NE Oregon Street
Portland, OR 97232

d. Annual Coordination. Meet with NMFS by March 31 each year to discuss the annual monitoring report and any action necessary to make the program more effective.

Sprague - Terms and conditions:

Terms and conditions were specified by NOAA Fisheries during ESA consultation to implement reasonable and prudent measures. These are included in the limitations incorporated into Alternative B, the proposed action, and are provided, verbatim, below.

Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The BLM has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the BLM fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions.

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of listed species resulting from completion of the proposed action.

The BLM Shall:

1. Minimize incidental take by ensuring that orchard pests are managed using IPM techniques that use treatment thresholds and minimize the need for pesticide application.
2. Minimize incidental take from pesticide applications by choosing pesticide formulas, timing, place, and manner of pesticide use to minimize the likelihood of delivery to riparian and aquatic systems.
3. Minimize incidental take from fertilizer application by ensuring that fertilizer is applied in a time, place and manner that minimizes the likelihood of delivery to surface and groundwater.
4. Ensure completion of an annual comprehensive monitoring and operations reporting program to confirm this Opinion is meeting its objective of minimizing take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BLM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary and, in relevant part, apply equally to proposed actions in all categories of activity.

1. To implement Reasonable and Prudent Measure #1 (integrated pest management) the BLM shall:

   a. Treatment Thresholds. Ensure that no action to suppress insect pests will be taken unless pest monitoring show that one or more pests have reached a threshold at which losses in seed yield and quality exceed the economic and environmental cost of treatment. No pesticide will be applied on a routine basis, without regard for treatment thresholds based on pest populations.
   b. Prescribed Burning. When prescribed burning will be used as a pest control, the following conditions will apply.
      i. Design the prescribed burn to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function.
      ii. Ensure that all vehicles, including emergency equipment, are not operated, maintained and stored next to any stream, waterbody or wetland. Equipment shall not disturb native riparian vegetation.
      iii. Ensure that all vehicles, including emergency equipment, are not fueled within 150 feet of any waterbody.
      iv. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to restore riparian ground cover and vegetation.
      v. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.
   c. Each supervisor engaged in IPM activities must be informed of the following requirement:

      NOTICE: If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NMFS Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

2. To implement Reasonable and Prudent Measure #2 (use of pesticides), the BLM shall ensure that:
   a. Spill Prevention Plan and Methods. Prepare and carry out a spill prevention plan to prevent contamination from spill of pesticides and other hazardous materials. The plan will contain the pertinent elements listed below, meet requirements of all applicable laws and regulations, and must be available for inspection on request by NMFS.
      i. The name and address of the party(s) responsible for accomplishment of the spill prevention plan.
      ii. A description of any regulated pesticide and other hazardous materials that will be used as part of the IPM Plan.
      iii. Training and certification for those who will be involved with pesticide transportation, storage, use, disposal, record keeping, monitoring, and emergency response.
      iv. Practices to prevent spills associated with mixing sites (i.e., containment), critical areas where spills are likely to occur, and environmental restrictions.
      v. Spill containment and notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available onsite, proposed methods for disposal of spilled materials.
   b. Timing of Pesticide Application. Time pesticide applications as follows.
      i. Prioritize applications for mornings or evenings when pollinators are not active

(as seasonally applicable) in accordance with the best overall weather period.

ii. Weather. Pesticides will not be applied under the following weather and soil conditions unless the product label specifically recommends otherwise.
   (1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. These methods shall be documented and included in the annual monitoring report.
   (2) In areas with standing water and saturated soils.
   (3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.
   (4) In wind that exceeds 6 miles per hour or blows toward flowing streams.

c. Areas of Pesticide Application.
   i. Application Buffers. Application methods shall be restricted by zones as follows. Zone widths refer distances from any intermittent or perennial stream or waterbody with flowing water, measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration zone, or the edge of any associated wetland, whichever is greater. These buffer widths shall not be decreased over the five-year term of this Opinion.
      (1) **<20 Feet.** Cultural methods, backpack, hand-held wick, injection using the Rodeo® formulation of glyphosate.
      (2) **>50 Feet.** Capsule implantation, hand sprayer, and hydraulic sprayer with handheld wand.
      (3) **>90 Feet.** All of the above, and tractor-pulled spray rig with boom and high-pressure hydraulic sprayer.

3. To implement Reasonable and Prudent Measure #3 (use of fertilizers), the BLM shall ensure that:

   a. Fertilizer will not be appliled within 50 feet of any stream, wetland or other waterbody.
   b. Fertilizer will be applied at agronomic rates.[17]
   c. Fertilizer loading (pertaining to application equipment) areas shall be at least 100 feet from perennial streams.

4. To implement Reasonable and Prudent Measure #4 (monitoring and reporting), the BLM shall ensure that:

   a. Annual monitoring report. All water quality monitoring information associated with application of the Sprague Seed Orchard IPM program shall be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' shall include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, shall be contained in an Annual Sprague Seed Orchard Monitoring Report. This report shall be available to the public and regulatory agencies on November 15 of each year and be on file at the Sprague seed orchard. This report shall include the following information:
      i. Project Identification.
         (1) BLM contact person.
         (2) Pesticide project manager.
         (3) Starting and ending dates for work completed.

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[17] 'Agronomic rate' means a quantity and timing of total nutrient application that does not exceed the requirements of the crop production and harvest or grazing system, as opposed to a nutrient application rate based on production goals that are difficult to define and variable. Calculation of the agronomic rate takes into account the total nitrogen or phosphorus resources for plant nutrition, and any retention of phosphorus in the soil and losses of nitrogen through denitrification and ammonia volatilization.

ii. IPM Documentation.
   (1) Description of how treatments were based on weather and pest monitoring.
   (2) A description of the biological and cultural pest controls used before pesticides were applied, or the reasons that biological and cultural controls were not used. Note that this provision is applicable to initial decisions to apply pesticides in response to pest population levels, not each individual application, and shall be documented within the annual monitoring report.

iii. Pesticide Use History.
   (1) Type of chemical applied.
   (2) Date of application.
   (3) Buffers present.
   (4) Method of pesticide application.
   (5) Total area treated.
   (6) Amount of pesticide applied.
   (7) Precipitation for the three days preceding and following application.
   (8) Wind direction and speed, relative humidity, air temperature at time of application.
   (9) Location used for mixing and loading and notes regarding whether any leakage or spills occurred.

iv. Effectiveness Monitoring.
   (1) Orchard units or treatment areas directly beside open water (within 100 feet) shall require drift cards be placed at a maximum of 100foot intervals along the edge of Sprague's unit before the application (for high-pressure hydraulic sprayer applications).
   (2) If open canopy occurs in the waterway buffer, drift cards shall be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Any applications shall cease if there is any indication that there is off-target delivery occurring.
   (3) Immediately after the application, the cards shall be collected and reviewed to determine if a drift signature is present, the extent of the drift, and the potential for aquatic contamination. A copy of all the cards shall be kept on file at Sprague, along with a record of their location and all the compliance monitoring documentation.

v. Surface Water Monitoring to Detect Drift.
   (1) For high-pressure hydraulic sprayer applications of chemicals, water samples shall be collected before and after spray application that include representative '15 minute' and '24-hour (composite)' post treatment water samples.
   (2) Surface water samples are collected within the project area, also, where appropriate, collect water samples concurrently where flowing water enters the project area to facilitate a baseline/cumulative concentration analysis.

vi. Surface Runoff.
   (1) Continuous flow recording stations shall be established in the intermittent stream on the west side of OU 53 if water is flowing in this drainage to collect water and water column sediment samples during runoff events with the intention of providing individual storm concentrations. If this site does not have enough water to be effective, the BLM shall investigate sites further down the drainage. SPMDs may be used to supplement flow-weighted concentration monitoring.
   (2) The data from recording stations shall be interpreted to be representative of water quality conditions as a result of the effectiveness of implemented protection measures and limitations in the higher-risk seed production areas.
   (3) All data shall be used in conjunction with continuous recorded climate data to evaluate the effectiveness of protection measures and limitations in minimizing introduction of pesticides and fertilizers to the aquatic system.

(4) Samples shall be analyzed at a state-certified laboratory at the lowest certified detection levels.

79 Surface Drift monitoring shall occur for the following compounds that are applied using the specific methodologies.

Application Method	Compound	Surface Water Drift Monitoring	Sites for Surface Water Drift Sampling	Sites for SPMD Placement
High pressure hydraulic sprayer	Esfenvalerate Chlorpyrifos Permethrin Diazinon Dimethoate Propargite Chlorothalonil	A representative stream[18] or streams will be sampled and tested for each application	OU West, 53 West, 42 East, 43 All, 44PP all	OU 53 West
Hydraulic sprayer w/ handheld wand	Esfenvalerate	Surface water sampling and testing for each application within 250 feet of surface water		
Backpack Sprayer - Hand-held wand	Esfenvalerate	Surface water sampling and testing for each application within 100 feet of surface water		

Note: For Orchard Unit numbers referenced above, see page76-78of the Sprague Biological Assessment.

vii. Cumulative Concentrations Runoff.

(1) Stormflow with the highest potential for chemical presence shall be sampled and, during these flow events, samples shall be composited according to the rise and fall of the hydrograph,

(2) SPMDs will be deployed, to monitor the accumulation of chemicals in waters containing aquatic species. SPMDs shall be used in the intermittent stream on the west side of OU 53 if water is flowing in this drainage to collect water and water column sediment samples during runoff events with the intention of providing individual storm concentrations. If this site does not have enough water to be effective, the BLM shall investigate sites further down the drainage.

(3) SPMDs shall be deployed before initial winter storms and spring storm periods after pesticide application.

(4) Stream flow gauges (USGS and BLM) shall be maintained to provide flow data for deriving concentrations (chemical loading) over the period of time the SPMD is deployed.

(5) Data from the SPMD concentrations shall be used to compare and validate the storm flow concentration monitored during the deployment period.

(6) SPMDs shall be strategically deployed in timeframes that are representive of potential exposure scenarios, such as runoff from significant rain events and or drift during application. SPMDs shall be deployed for approximately 30 days, though smaller time increments are encouraged because they are more sensitive to pulses of pesticides.

[18] A representative stream is any stream beside a spray unit, downwind of a spray unit, or otherwise liekly to be affected if dirft outisde the treatment units occurs.

vii. Validation Monitoring. For select sites, monitoring shall be used to validate the water quality modeling predictions presented in the EIS and BA.
(1) Concentrations shall be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.
(2) If detectable concentrations are found, stream concentrations shall also be compared to model results using actual application information, field-specific data, and continuous climate record. These data shall provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.
(4) A collection chamber shall be installed where there is overland flow in OU53. During the first overland flow event following select chemical applications, this sites shall be visited, and a water sample taken from the collection chamber, these data shall be used
to assess the mobility of chemicals that have been used onsite within the past year.
(5) For select sites and once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.

viii. Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, shall be immediately evaluated to determine if water sampling is desirable and necessary. If the spill occurs in an area that is reasonably certain to deliver to surface waters, either immediately, or on the next precipitation event, sampling shall occur, as appropriate. Water samples shall be collected in a sufficient number and at surface water and groundwater locations that shall allow characterization of impacts and effective remediation methods. Depending on ODEQ Monitoring Hazardous Substances Remediation Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil.

ix. Groundwater Monitoring. The two irrigation and three irrigation/domestic wells and one proposed test well at Sprague shall be used for monitoring of groundwater contamination. The pesticides chosen shall vary according to the rates, persistence, and mobility of the pesticides applied during the period since the last sampling. These samples shall occur annually, and normally be collected in late summer and handled according to state-certified laboratory instructions.
(1) Groundwater monitoring wells associated with the greenhouse effluent field shall be monitored. Water quality sampling shall be conducted when risks are highest for irrigation water to potentially reach the local ground water table. If 'point in time' samples are found to have detectible levels of the pesticide, SPMDs shall also be deployed in selected wells to allow a more quantitative determination of concentration over time.
(2) Notification of Discharge. If a surface water discharge occurs, the BLM shall notify NMFS within 10 business days of detection. Notification shall include the type, location, and concentration of the discharge.

x. Circumstances that would trigger reinitiation:
(1) More than one discharge per zone, as defined in this Opinion, between the 'low trigger' and 'high trigger'; values (within any one year). Note that discharges below the low trigger value are not applicable to this total.
(2) A discharge within any one year above the 'high trigger' value.
(3) For compounds with a common mode of action (i.e. pyrethroids and

organophosphates), if the sum total of the toxic units is >0.05 (equivalent to 1/20th of the standardized LC50s) it will be counted as a 'low trigger' exceedence. If the sum total of the toxic units is > 0.5 (equivalent to 1/2 of the standardized LC50s) it will be counted as a 'high trigger' exceedence. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column). The toxic units for each class, pyrethroids, and organophosphates, will be calculated as outlined within this Opinion. Only one 'low trigger' exceedence will be counted if there is a toxic unit 'low trigger' exceedence for a particular chemical family that contains a 'low trigger' exceedence of an individual compound within that same chemical family.

(4) To account for the synergistic action of pyrethroids and organophosphates, as described within this Opinion, an exceedence of a 'low trigger' of both a pyrethroid and an organophosphate (either individually or as a sum total of family toxic units) will be considered the equivalent of exceeding a high trigger. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column), and includes SPMD data.

(5) Upon any SPMD detection, the data shall be used to provide a 24-hour average waterborne contaminant concentration for the chemicals that were applied and can be sequestered. To reflect the margin of error within the SPMD methodology, a two-fold safety factor (Huckins 2004) shall be applied to the back calculated 24-hour average concentration (multiply the value by two). The corrected 24-hour concentration shall then be treated as a discharge within the final monitoring plan and the same circumstances apply for reinitiation.

(6) An annual review of SPMD data collection, data use, and sampling methodology may occur. In the event of a detection, factors leading to the resultant discharge concentration shall be reviewed.

c. Annual Operation Report. The Annual Operation Report will be submitted to NMFS by December 1st, and include the following information (NMFS will review the Annual Operation Report within 30 business days of its receipt, note that the annual operations plan for 2005 only needs to include data specified within number (5)):

i. The results of the previous year monitoring program. If a discharge occurred during the previous year, possible causes of the discharge shall be explored, as well as future mitigation steps to prevent like discharges in the future.

ii. A data review of the pesticides that are proposed for use, or may be used, at Sprague in the following year. The review shall include:

(1) New scientific data regarding non-target fish species effects or environmental fate.

(2) Changes to EPA-approved labels (ESA-approved and other).

(3) A review of legal findings relevant to the use of pesticides.

(4) A plan for proposed pesticide applications for the following year, including, to the extent possible, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored.[19]

(5) Any proposed changes to the IPM, including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those proposed; or other relevant information.

(6) The annual report shall be sent to:

Director, Oregon State Habitat Office NMFS
Attn: 2004/00206
525 NE Oregon Street
Portland, OR 97232

d. Annual coordination. Meet with NMFS by March 31 each year, as necessary, to discuss the annual monitoring report and any action necessary to make the program more effective.

How is Alternative B Different from Alternative A?

Under Alternative B, all of the same pest control methods are available to the seed orchard manager as under Alternative A. However, Alternative B contains specific limitations (see list above) on certain aspects of chemical pesticide use to provide added protection to human health and the environment. Commonly, during the preparation of an EIS, the analysis of impacts occurs wholly during the EIS development process. In the case of the proposed IPM program at Provolt and Sprague Seed Orchards, a quantitative risk assessment of the proposed chemical pesticides and fertilizers was completed *before* development of the EIS alternatives. The assumptions made during this risk assessment correspond to the pesticide application details of Alternative A. The conclusions of this assessment, and the interaction among the interdisciplinary team members during the assessment, directly resulted in developing a new alternative—Alternative B—that addresses all the predicted risks in the risk assessment scenarios, as well as protects resources based on these experts' site-specific knowledge of overall potential chemical transport pathways at the seed orchards.

What are Limitations, Protection Measures, and Mitigation Measures?

These three concepts may seem similar, but they have distinct definitions within this EIS:

Limitations are the list of exceptions in Section 2.3.3 that distinguish the details of potential pesticide applications under Alternative B from those under Alternative A. These limitations were designed by the interdisciplinary team preparing this EIS to address predicted risks, respond to scoping concerns, and provide additional environmental protection. Limitations include the terms and conditions specified by NOAA Fisheries during ESA copnsultation; these requirements are inherent in Alternative B, the proposed action.

Protection measures are best management practices (BMPs), including BMPs for water quality protection under the *Clean Water Act*,[1] that would be implemented during any use of chemical pesticides by Provolt or Sprague, regardless of the alternative selected. Protection measures are listed in Section 2.3.1.

Mitigation measures are defined by CEQ (40 CFR 1508.20) as (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or (e) compensating for the impact by replacing or providing substitute resources or environments. Mitigation measures are not specifically included in an alternative, but are additional measures in response to the potential environmental impact(s) that an alternative may have. Potential mitigation measures for the alternatives in this EIS are listed in Section 4.12, and, if needed, would be specifically identified in the ROD to correspond to the selected alternative. Alternative B, as the proposed action, also includes the terms and conditions identified by NOAA Fisheries during consultation under Section 7 of the ESA.

[1]BMPs in relation to water pollution are defined by EPA as "methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources."

2.3.4 Alternative C—Non-Pesticide Pest Management

Alternative C would allow the seed orchard manager to use only the non-pesticide biological, prescribed fire, cultural, and other methods listed under Alternative A. No biological or chemical pesticides would be permitted.

2.3.5 Alternative D—No Action: Continue Current Management Approach

Alternative D would allow continuation of the current management system, which is the use of all non-pesticide pest control practices at the seed orchard, as well as the use of pesticides on a specific case-by-case basis. All non-pesticide biological, prescribed fire, cultural, and other methods would be used and expanded beyond present use in accordance with current procedures. When a specific need is identified for a pesticide, the action would be reviewed to determine whether it is encompassed by an existing NEPA document. For example, weed control projects could be within the scope of the Northwest Area Noxious Weed Control Program EIS and Supplemental EIS, and the EIS for Vegetation Treatment on BLM Lands - Thirteen Western States. In addition, a project-specific EA was prepared for the 1999 through 2003 use of glyphosate at Sprague and the 2001 and 2004 use of glyphosate at Provolt to spot-treat noxious weeds. Section 1.4.1 provides more information on existing NEPA documents related to pest management. When specific proposed pesticide applications are not within the scope of an existing EA or EIS, another NEPA document would be prepared. The future anticipated use of chemical pesticides under this alternative would be as follows:

- The continued use of glyphosate or triclopyr, one to two applications per year at both orchards, as spot sprays for noxious weed control.
- Cone and seed insect control at Provolt would be proposed as esfenvalerate applications, one to two times per year in 15 to 18 orchard units, approximately every other year or when harvestable cone crops occur in the orchard. The use of chemical insecticides for controlling cone and seed insects at Sprague is not likely to be proposed under this alternative.

2.3.6 Alternative Considered But Not Further Analyzed

During the scoping process, one member of the public suggested planting more crop trees than necessary to allow for some loss to pests, which was interpreted as a request to consider no pest management at all. This is not a viable alternative for several reasons. First, this approach could lead to a significant loss of the crop trees in the production units if disease were to occur. Secondly, orchard research has shown that approximately 70% of the seed crop could be lost if no pest management were practiced (Schowalter et al. 1985). To partially offset the effects of cone and seed insects and decreased tree vigor due to disease, it would be necessary to plant production trees in fields that are currently fallow, as the commentor suggested. This solution would require the seed orchards and their cooperators to accept an estimated 10-year reduction in seed production, which is the time that would be required for the newly planted trees to produce collectable seed. This decrease in production could also result in delays in reforestation projects caused by potential seed shortages, or reduced forest growth resulting from the use of genetically inferior seed from other sources. In addition, a more intensive planting regime on seed orchard lands, with no pest management of any kind, would allow the orchard grounds to become a "reservoir" for insects, disease, noxious weeds, and animal pests that would spread to neighboring public and private lands—effectively, becoming a threat and nuisance to the neighbors, particularly those who cultivate crops of their own.

2.4 Approval of New Products and Technologies

It is likely that, over the life of the proposed IPM program, BLM seed orchard personnel will become aware of chemicals or non-chemical control methods that are currently available but were not described in this EIS, or that represent new technologies not currently available or practiced. This section describes how BLM would ensure compliance with U.S. laws (including NEPA) and regulations, and evaluate these new approaches for inclusion in the seed orchard's pest management plans, in terms of both their efficacy and their potential environmental impacts. This information applies both to full-scale use as a control method, as well as to field research projects investigating the potential for larger applications.

This approach includes descriptions of how new chemical products or technologies would be examined for consideration by BLM, what data would be relied upon to assess a product or technology's effectiveness for use on public lands, what data would be relied upon to conduct human health hazard and risk assessment, and the level of NEPA documentation required to support a decision to use or not use a product or technology.

2.4.1 Identification of New Chemical Products and Technologies

The seed orchard manager and employees may become aware of new pest control products and technologies through three general mechanisms: professional networking, technical research and publications, and vendor marketing.

Networking

Participation in professional networks is the principal method for staying current on new pest control approaches, and yields information on the technical, regulatory, efficacy, and environmental aspects of methods, both those in the development phase and those currently on the market. The primary professional association for BLM seed orchard managers in Oregon is the Northwest Seed Orchard Managers Association (NWSOMA), and particularly its Northwest Pest Management Committee. For nursery and greenhouse managers, the primary professional associations are the Western Forest and Conservation Nursery Association and the Intermountain Container Seedling Growers Association.

The Southwest Oregon Forest Insect and Disease Service Center is a group of U.S. Forest Service pathologists and entomologists that provide forest insect and disease technical assistance, field consultation, modeling, risk assessments, and historical information to Federal resource managers in southwest Oregon. A field service center is located near BLM's Medford District seed orchards at the Forest Service's J. Herbert Stone Nursery in Central Point. Similar services are also available in the Forest Service's regional office in Portland.

Useful information can also be obtained by staying in contact with other non-regional professional networks with similar goals, such as the Southern Seed Orchard Pest Management Subcommittee of the Southern Forest Tree Improvement Committee (part of the North Carolina State University Industry Cooperative Tree Improvement Association). Similarly, the British Columbia Seed Orchard Association, which often has formal interactions and collaborations with NWSOMA, is another professional network focusing on seed orchard management.

Technical Research and Publications

The U.S. Forest Service conducts extensive research activities that support tree improvement and re-forestation activities. The web page USDA/FS Research

Publications (http://216.48.37.142/) provides a search function that indexes Forest Service research publications, by keyword or by research station.[8] The Forest Service's Reforestation Nurseries and Genetics Resource web page (http://www.rngr.fs.fed.us) includes current information on seed orchard and tree nursery practices and pest management.

The IR-4 Ornamentals Research Program, organized by the state land grant universities and the U.S. Department of Agriculture (USDA), assists in collecting data that can be used to add minor crop (including seed orchard tree species) uses to existing chemical and biological pesticide registrations. The program's activities are described in detail at its web site (http://pestdata.ncsu.edu/ir-4/).

The Washington State Commission on Pesticide Registration is a state-funded regional program with a similar mandate (http://wscpr.org/).

Vendor Marketing

Vendors of pest control technologies, including chemical company representatives, occasionally contact BLM's seed orchards to introduce new products. These contacts may come in the form of mailed brochures or advertisements, or telephone contacts to request a visit to the seed orchard.

From time to time, members of the public who are interested in various approaches to pest management send information to the seed orchard manager describing these methods. As with pest control methods identified through other avenues, if the seed orchard manager determines that the approach may have some utility for the seed orchard's needs, a product demonstration or additional information may be requested.

2.4.2 Assessment of Effectiveness

The seed orchard manager would be the one to judge whether a previously unconsidered pest control product or technology is likely to be effective in meeting the specific seed orchard's pest control needs. The decision would be based on details such as previous use reports at other sites and their outcomes, availability, cost, expected effectiveness compared to any currently used methods, training and personnel requirements, factors that could limit efficacy, and any other relevant factors (including hazards and risks—see Section 2.4.3 below).

Any new chemical or biological pesticide considered for use by the seed orchards must be registered under FIFRA, which requires product performance data relating to its effectiveness. This requirement was designed "to ensure that pesticide products will control the pests listed on the label and that unnecessary pesticide exposure to the environment will not occur as a result of the use of ineffective products" [40 CFR 158.202(i)]. Therefore, any new pesticide registered under FIFRA is expected to be generally effective for the labeled uses. To further assess the potential for site-specific effectiveness prior to an actual application in the seed orchard, the seed orchard manager would investigate its use through professional networks, technical publications, and/or research reports, such as those described in the previous section.

For a pest control technology that is not required to be registered under FIFRA, the avenues of research described in the previous section would be the likely initial means for discovering its advantages and limitations over currently used methods. This could

[8] This and other Internet citations (uniform resource locators, or URLs) in this EIS were accurate at the time of publication. However, websites change frequently due to changes in data availability or reorganization of information, and the cited URLs may not work in the future. If this occurs, "backing up" to a less specific web address or using an Internet search function may allow retrieval of the information.

pertain to cultural control practices, tools or equipment, or other means that are not considered pesticides under the purview of FIFRA.

2.4.3 Assessment of Hazards and Risks

As stated in the previous section, BLM only uses pesticide products that are registered under FIFRA. Therefore, for any chemical or biological pesticide that may be considered for use in the seed orchard, there would exist a body of EPA-reviewed toxicological, environmental fate, and ecotoxicity data that were submitted by the pesticide manufacturer to support its registration application. These data can be used to conduct a site-specific assessment of the potential human health and ecological risks from the pesticide's use at the seed orchard, including the following components:

- Identification of potential use patterns, including target pest(s), formulation, application method(s), locations to be treated, application rate, and anticipated frequency.

- Review of chemical hazards relevant to human health risk assessment, including systemic and reproductive effects, skin and eye irritation, dermal absorption, allergic hypersensitivity, carcinogenicity, neurotoxicity, immunotoxicity, and endocrine disruption.

- Estimation of exposure to workers applying the chemical or re-entering a treated area.

- Environmental fate and transport, including drift, leaching to groundwater, and runoff to surface streams and ponds.

- Estimation of exposure to members of the public.

- Review of available ecotoxicity data, including hazards to mammals, birds, reptiles, amphibians, fish, and aquatic invertebrates.

- Estimation of exposure to terrestrial and aquatic wildlife species.

- Characterization of risk to human health and wildlife.

If the available toxicity or ecotoxicity data are inconclusive, or substantial disagreement occurs among the results of technical studies that could affect the potential risk conclusions for the chemical, BLM could conduct a formal peer review of the available scientific information to develop a consensus as to the endpoint(s) in question. The peer review process would include the following steps, based largely on EPA's peer review process (EPA 2000b):

- BLM would conduct a literature search of studies submitted to EPA, studies published in professional journals, and research projects conducted by other government agencies or universities. The identified literature would be indexed and abstracted.

- A peer review committee would be formed, consisting of reviewers with recognized technical expertise that bears on the subject matter under discussion, who represent a balanced range of technically legitimate points of view, and who do not have any real or perceived bias or conflict of interest. The peer reviewers would be supplied with their charge, the results of the literature review, and a description of the issue at hand.

- The input of each reviewer would be sent to BLM. If the results of the peer review are not consistent at this point, a working session would be convened, in which the peer reviewers would come together to discuss the technical aspects of the questions and attempt to reach a consensus.

The details of the peer review process would be determined by the question to be answered and the nature of the controversy. To the extent they are relevant, the guidelines and processes in EPA's *Peer Review Handbook* (EPA 2000b) would be followed.

For assessment of the hazards and risks from non-pesticide methods (biological controls, cultural controls, and other methods), BLM would review the potential for impacts to worker health and safety, public health and safety, and special status species and their habitat. Limited-scale field trials could assist in identifying potential hazards from a non-pesticide method under consideration, as well as in determining the effectiveness of any new approach.

2.4.4 NEPA Documentation

The potential use of new technologies or products for pest control in the seed orchard would require a review to ensure compliance with NEPA. The review would follow the process outlined in the BLM NEPA Handbook (H-1790-1), Chapter 1 (BLM 1988), and would consist of the basic steps described below and outlined in Figure 2.4-1.

Step 1. Conduct a CX Review

The first step in this review is to determine whether the new action is within the scope of a Department of Interior or BLM CX (516 DM 2, Appendix 1; and 516 DM 11.5, respectively) (DOI 1980). These two lists constitute *List C*, as identified in Figure 2.4-1. Based on an initial review of this list, there appear to be only two CXs, both within the Forestry areas on the BLM list, that have the potential to cover a new technology or product relating to seed orchard operations (516 DM 11.5 c (1) and (3)):

- Land cultivation and silvicultural activities (excluding herbicides) in forest tree nurseries, seed orchards, and progeny test sites.

- Seeding or reforestation of timber sales or burn areas where no chaining is done, no pesticides are used, and there is no conversion of timber type or conversion of non-forest to forest land. Specific reforestation activities covered include: seeding and seedling plantings, shading, tubing (browse protection), paper mulching, bud caps, ravel protection, application of non-toxic big game repellant, spot scalping, rodent trapping, fertilization of seed trees, fenced construction around out-planting sites, and collection of pollen, scions and cones.

Therefore, some non-pesticide methods could be within the scope of an existing CX.

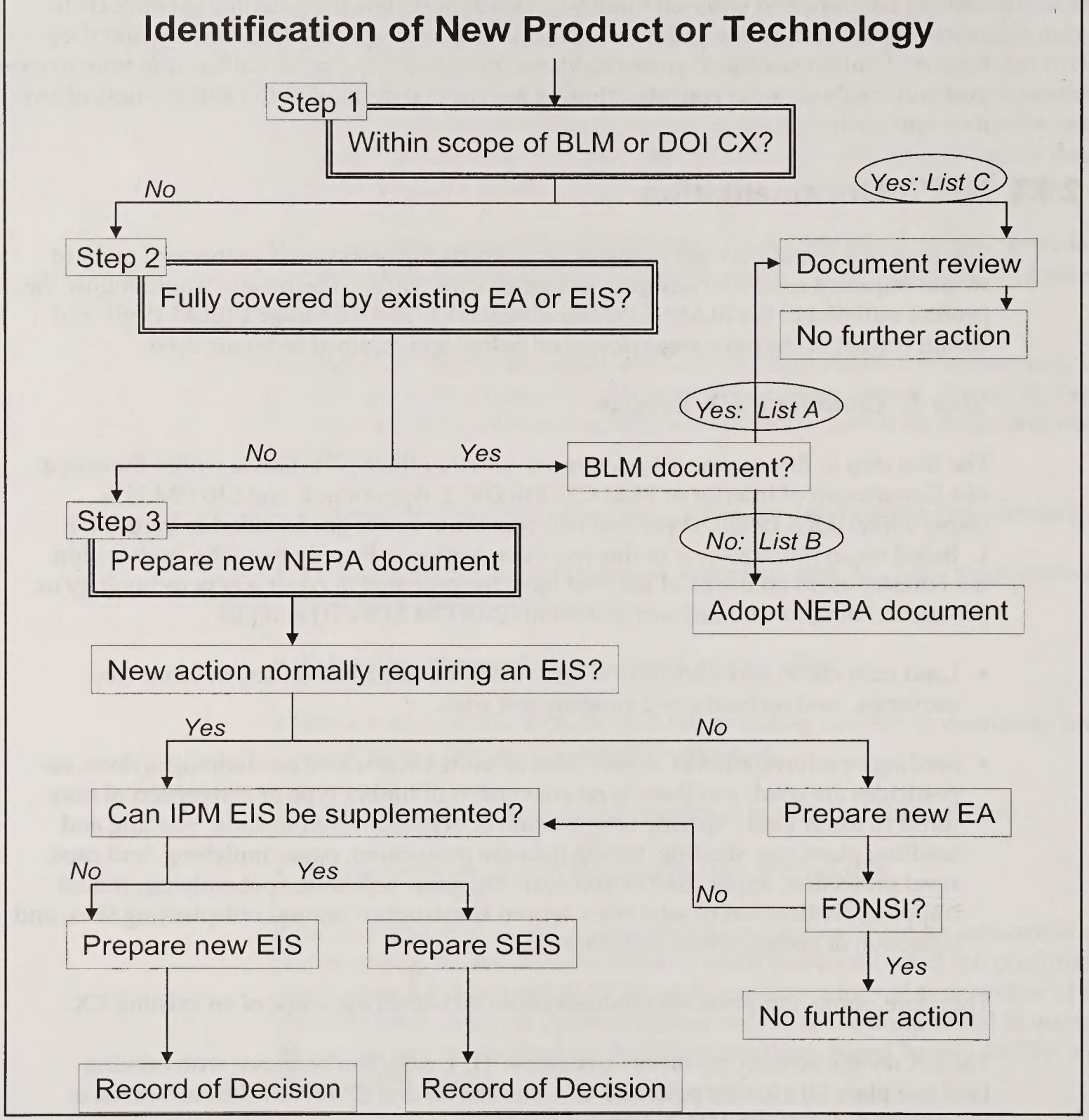
The CX review actually involves three steps: (1) ensure conformance with existing land use plan; (2) identify potential CX—see above; and (3) review the current list of exceptions to CX at 516 DM 2, Appendix 2.

If the new action is within the scope of a CX, and none of the exceptions applies, the CX review would be documented and then no further action would be required. If a CX was not identified or one or more of the exceptions were met, then BLM would proceed to **Step 2.**

Step 2. Review Existing EAs and EISs

The following types of existing NEPA documents would be reviewed to determine whether any have fully covered the use of the proposed new product or technology:

Figure 2.4-1. NEPA Review of New Products and Technologies



BLM NEPA Documents (List A)

- This seed orchard-specific IPM EIS.
- EISs associated with the District RMP or Plan amendments.
- Programmatic documents such as the EIS for Vegetation Treatments, Watersheds and Wildlife Habitats on Public Lands Administered by the BLM in the Western United States, Including Alaska (currently in preparation).
- Any seed orchard-specific EAs that have been prepared for pest management or operations.
- NEPA documents prepared by other Federal agencies, with BLM as a cooperating agency.

Other Agency NEPA Documents (List B)

- NEPA documents for which BLM was not listed as a cooperating agency, but for which the scope is relevant to evaluation of the proposed pest management method. Possible source agencies could include the Forest Service, National Park Service, Animal and Plant Health Inspection Service, and the military services.

Generally, existing NEPA documents may be used when: (1) a current proposed action was previously proposed and analyzed (or is part of an earlier proposal that was analyzed); (2) resource conditions and other relevant circumstances have not changed significantly, and there is no significant new information germane to the proposed action; and (3) there is no suggestion by the public of a significant new and appropriate alternative (BLM 2001).

The review would focus on the following questions to determine whether the existing document(s) satisfy NEPA analysis requirements for the proposed new pest management method (BLM 2001):

- Is the current proposed action substantially the same action (or is a part of an action) as previously analyzed?

- Is the range of alternatives analyzed in the existing NEPA document(s) appropriate with respect to the current proposed action, given current environmental concerns, interests, resource values, and circumstances?

- Is the existing analysis adequate and are the conclusions adequate in light of any new information or circumstances (including, for example, riparian proper functioning condition [PFC] reports; rangeland health standards assessments; Unified Watershed Assessment categorizations; inventory and monitoring data; most recent Fish and Wildlife Service and NOAA Fisheries lists of threatened, endangered, proposed, and candidate species; most recent BLM lists of special status species)? Can you reasonably conclude that all new information and all new circumstances are insignificant with regard to analysis of the proposed action?

- Do the methodology and analytical approach used in the existing NEPA document(s) continue to be appropriate for the current proposed action?

- Are the direct and indirect effects of the current proposed action substantially unchanged from those identified in the existing NEPA document(s)? Does the existing NEPA document sufficiently analyze site-specific impacts related to the current proposed action?

- Can you conclude without additional analysis or information that the cumulative impacts that would result from implementation of the current proposed action are substantially unchanged from those analyzed in the existing NEPA document(s)?

- Are the public involvement and interagency review associated with existing NEPA document(s) adequately [sic] for the current proposed action?

If all the criteria are met and the existing document is a BLM document or one with BLM as a cooperating agency, then the analysis and results would be documented using the Documentation of Land Use Plan Conformance and NEPA Adequacy, described in BLM Instruction Memorandum No. 2001-062 (BLM 2001). Reliance on existing NEPA documents requires the establishment of an administrative record that clearly shows a "hard look" has been taken at whether new circumstances, new information, or environmental impacts not previously anticipated or analyzed warrant new analysis or supplementation of existing analyses, and whether the impact analysis supports the

proposed action. The review must be conducted through an interdisciplinary process, and the resulting documentation must adequately address the criteria included in the worksheet contained in BLM (2001). If existing NEPA documentation is found to be adequate, this must be documented on the worksheet, which must also include a signed conclusion statement. Approval of the proposed action requires a Finding of No Significant Impact (FONSI) decision document.

If existing NEPA documentation is found to be adequate, but BLM is not formally a cooperating agency on the document, then BLM would adopt the document to comply with NEPA; adoption would be in accordance with the requirements set forth in 40 CFR 1506.3. If existing NEPA documentation was determined to be inadequate, completion of the worksheet is not required and either the proposal would be rejected or BLM would proceed to **Step 3**.

Step 3. Prepare a New NEPA Document

This step can be further broken down into two sub-steps: (a) what level of NEPA review is required (EA or EIS); and (b) can portions of an existing document(s) be used in preparation of the new NEPA document?

To determine the level of NEPA review needed, the action should be compared to the actions typically requiring preparation of an EIS (516 DM 11.4). Depending on the outcome, it may be appropriate to tier to, supplement, or incorporate by reference parts or all of existing document(s) as part of the document preparation process:

- *Tiering* (40 CFR 1508.28) could be used to prepare new more specific or more narrow environmental documents (such as an EA for the proposed activity) without duplicating relevant parts of previously prepared, more general or broader documents (such as the IPM EIS). Tiering is mostly used to avoid unnecessary paperwork. Documents can be tiered only if decisions made in the new document would not change or modify the decision(s) of the more general document.

- *Supplementing* (40 CFR 1502.9c) is most often used to address alternatives not previously analyzed and may lead to a new decision. In this instance, a supplemental EIS (SEIS) could be prepared to the IPM EIS. Supplemental documents are generally prepared when there is a substantial change in the proposed action that is relevant to environmental concerns; that is, if there are significant new circumstances or facts relevant to environmental concerns and bearing on proposed action or impacts that were not addressed in existing analysis. If the existing IPM EIS is supplemented, the same standard procedural and documentation requirements for EISs are followed (see Chapter 5 of BLM Handbook), except that additional scoping is optional. In addition, the SEIS must identify the EIS being supplemented and explain the relationship to the prior analysis early in the text. Further, the SEIS should identify changes in the proposed project and/or significant new information or changed circumstances that necessitate preparation of the supplement.

- *Incorporating by reference* (40 CFR 1502.21) is a technique used to avoid redundancies in analysis and to reduce the bulk of a NEPA document. An EA or EIS must identify the documents that are incorporated by reference and indicate where they are available for public review. Relevant portions of the incorporated analysis must be referenced by page number, and summarized in the EA or EIS to the extent necessary to provide the decisionmaker and public with an understanding of significance of the referenced material to the current analysis. The new NEPA document must be able to stand alone.

Preparation of a new EA would follow the procedures outlined in the BLM NEPA Handbook, Chapter 4. Preparation of a new EIS or SEIS would follow the procedures

outlined in the BLM NEPA Handbook, Chapter 5 (including, where appropriate, tiering, supplementing, and incorporating by reference, as noted above). The EA process would end in issuance of a FONSI or a determination of the need to prepare an EIS. The EIS process would end with issuance of a ROD.

2.5 Ongoing and Reasonably Foreseeable Future Actions in Study Area

Implementing the proposed action or an alternative at Provolt or Sprague would be concurrent with other actions at the orchard and adjacent lands; these actions could contribute to cumulative impacts to some resources. Both orchards plan only routine operations, and expect no construction or other unusual activities that would contribute to cumulative impacts. Routine operations at Provolt include irrigation ditch maintenance activities, such as the use of herbicides to prevent vegetation from impeding water flow (BLM 2002).

Lands adjacent to Provolt are used primarily for rural residences and agriculture, including corn, grains, hay, pasture, and dairy operations. Some or all of the farm operations could include applications of agricultural chemicals, and some rural residents may use yard chemicals. No major construction or development projects are planned at this time. There are no other activities known to occur on adjacent properties that would contribute to cumulative impacts (BLM 2002).

The areas surrounding Sprague include rural residences, and woodlands that are gradually being re-zoned to residential use. Isolated residential construction, with associated water well installation, is occurring, but no large-scale developments are planned. There are no other activities known to occur on adjacent properties that would contribute to cumulative impacts (BLM 2002).

2.6 Summary of Environmental Impacts by Alternative

Areas of potential concern for the proposed action and alternatives were identified based on input from BLM interdisciplinary team members, consultation with Federal and state agencies, scoping comments, and comparisons with similar activities. The potential impacts were evaluated and are described in Chapter 4.

As defined in CEQ's regulations for implementing NEPA, determining whether an environmental impact is "significant" requires consideration of both context and intensity. In the resource-specific subsections of Chapter 4 of this EIS, the criteria used to define each impact's significance are described under the sub-heading "Analysis Approach and Assumptions."

Table 2.6-1 summarizes the environmental impacts for each resource by alternative. Table 2.6-1 is provided as an attachment at the end of this chapter, following Table 2.2-1.

The resource-specific assessments in Chapter 4 are organized according to a logical flow of analysis. Effects on the physical environment (for example, surface water) must be determined before effects on the associated resources (such as aquatic species) can be assessed. This same sequence of resources is maintained in Table 2.6-1. However, scoping concerns would dictate a different priority for considering the results, in which the following four resources are of greater importance than the others for purposes of decisionmaking: human health and safety, water quality, soils, and wildlife and aquatic species. The analysis predicted no significant impacts to soils. Comparison of potential

impacts among the remaining three resources provides the critical information to be considered by the decisionmaker in preparing the ROD for this EIS:

Human Health and Safety

- There are no significant risks to members of the public from the proposed use of any of the control methods under any of the alternatives. However, under Alternatives A, B, and D, an accidental spill of pesticide to a stream could make surface water unsafe for drinking or fishing.

- Under Alternatives A and D, there is a possibility of health effects for workers from some chemical pesticides. No risks of worker health effects were predicted for pesticide applications under Alternative B. Under Alternatives A, B, and D, an accidental spill onto the skin could cause health risks. Under all of the alternatives, there is a possibility of injury from cultural or prescribed fire methods.

Water Quality

- No significant impacts to groundwater quality were predicted under any alternative.

- Runoff or drift from pesticide or fertilizer applications could enter streams and rivers under Alternatives A, B, and D; and fertilizers could enter surface water in runoff under Alternative C. The effects of the estimated stream concentrations on human health and aquatic species are described under those headings. Under Alternative B, limitations would be in place to control the potential for runoff and drift of pesticides.

- An accidental spill of pesticide concentrate or mix could contaminate groundwater or surface water under Alternatives A, B, and D. A spill of fertilizer could contaminate groundwater or surface water under all alternatives.

Biological Resources

- No adverse impacts to non-target vegetation are expected under any of the alternatives.

- There are possible risks to terrestrial wildlife species from three of the proposed insecticides under Alternatives A and D. Lethality would be expected for non-target insects in an area treated with insecticide under Alternatives A, B, and D. No significant impacts to terrestrial wildlife were predicted under Alternatives B and C.

- There are no significant risks to aquatic species from use of the chemical, biological, prescribed fire, or cultural control methods under any of the alternatives. Under maximum runoff conditions, fertilizer could cause impacts to special status species in the main tributary to Jump-off Joe Creek at Sprague; no aquatic species risks from fertilizers were predicted at Provolt. Under Alternatives A, B, and D, there could be adverse impacts to aquatic species from an accidental spill of pesticide to a stream.

Alternative B, the proposed action, is BLM's preferred alternative for minimizing long-term impacts to all resources, including human health.

Table 2.2-1. Pesticide and Fertilizer Application Summary[a]

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Insecticides					
Acephate: Acecap® 97 (97% a.i. in an implant capsule) *Target pests: defoliating insects, Douglas-fir coneworm, Douglas-fir cone moth*					
Implants	Individual trees in any orchard unit	1 capsule/4 inches circumference 1 application to 100 trees	1 capsule/4 inches circumference 1 application to 300 trees	Mar - Apr (Provolt) Mar - Jul (Sprague)	Every 1 to 3 years (Provolt) Seldom: 1 to 2 times in a 1-year period (Sprague)
B.t.: Deliver® (18% active toxin as a wettable granular bioinsecticide) *Target pests: tussock or gypsy moth, and other invasions of larvae of lepidopterous insects*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Sensitive areas, buffer areas, administrative areas	0.27 lb a.i./acre, in water at 100 gal/acre 1 to 2 applications to 500 trees on 5 to 10 acres	0.27 lb a.i./acre, in water at 100 gal/acre 2 to 3 applications to 1,000 trees on 10 to 20 acres	Mar - Jul	Every year of a harvestable cone crop
Chlorpyrifos: Dursban 50W (50% a.i. as a wettable powder in water-soluble packets) *Target pests: sucking insects and mites, defoliating insects such as tussock moth and gypsy moth, and rare use for cone and seed insects such as cone moths and cone worms*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Individual trees in any orchard unit	1 lb a.i./acre, in water at 100 gal/acre (0.02 lb a.i./tree) 1 application to 300 trees (Provolt) 1 application to 100 trees on 20 acres (Sprague)	2 lb a.i./acre, in water at 100 gal/acre (0.04 lb a.i./tree) 1 application to 300 trees and an additional application to 150 trees (Provolt) 1 application to 300 trees on 20 acres and an additional application to 150 trees on 10 acres (Sprague)	May - Sep	Seldom: 1 to 2 times in a 10-year period

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Diazinon: Diazinon 50W (50% a.i. as a wettable powder) *Target pests: ants, spiders, moths, aphids, mites, or other serious insect outbreaks in the administrative and landscaping areas, or in isolated orchard locations when small but serious insect damage needs attention*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Individual trees in any orchard unit	0.015 lb a.i./tree, in water at 3 gal/tree 1 application to 100 trees on 20 acres	0.075 lb a.i./tree, in water at 5 gal/tree 1 application to 300 trees on 20 acres and an additional application to 150 trees on 10 acres	Apr - Sep	Seldom: 1 to 2 times in a 5-year period
Dimethoate: Digon 400 (43.5% a.i. as a liquid concentrate) *Target pests: Douglas-fire cone gall midge (Provolt); larvae of sawfly species and other foliar damaging insects (Sprague)*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any production orchard unit	0.13 lb a.i./tree, in water at 2 gal/tree 1 application to 500 trees	0.34 lb a.i./tree, in water at 4 gal/tree 2 applications to 500 trees	Apr - Sep	As a back-up or alternate to esfenvalerate (Provolt) 1 to 2 times in a 5-yeaar period (Sprague)
Esfenvalerate: Asana® XL (8.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir cone worm, western conifer seed bug, Douglas-fir seed chalcid, Douglas-fir cone moth, Douglas- fir cone gall midge*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any production orchard	0.001 lb a.i./tree, in water at 2 gal/tree 2 applications to 1,700 trees (Provolt) 2 applications to 500 trees (Sprague)	Cumulative maximum = 1.6 lb a.i./ acre per year 0.002 lb a.i./tree, in water at 4 gal/tree 2 applications to 1,700 trees (Provolt) 2 applications to 500 trees (Sprague)	Apr - Jul (Provolt) May - Jul (Sprague)	Annual (Provolt) Every 2 to 3 years (Sprague)

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Horticultural Oil: Dormant Oil 435 (98.8% paraffinic hydrocarbon oil) *Target pests: used in sensitive treatment areas near waterways, near property boundaries, along roadways, or any buffer area not being treated with chemicals, or as an additive with insecticides, or as a dormant treatment for mites and insect pupae*					
High-pressure hydraulic sprayer	Individual trees in any orchard, as an additive to other insecticides, fungicides, or miticides; or alone as a dormant spray	0.03 gal oil/tree, in water at 3 gal/tree 2 applications to 350 trees (Provolt) 2 applications to 200 trees (Sprague)	0.05 gal oil/tree, in water at 5 gal/tree 2 applications to 350 trees (Provolt) 2 applications to 200 trees (Sprague)	Mar - Sep (as an additive) Sep - Jul (as a dormant oil)	Every 1 to 2 years as an alternate or supplement to non-chemical treatments
Sprague only: Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard, as an additive to other insecticides, fungicides, or miticides; or alone as a dormant spray	0.01 gal oil/tree, in water at 1 gal/tree 2 applications to 200 trees	0.03 gal oil/tree, in water at 3 gal/tree 2 applications to 200 trees	Mar - Sep (as an additive) Sep - Jul (as a dormant oil)	Every 1 to 2 years as an alternate or supplement to non-chemical treatments
Imidacloprid: Imicide® (10% a.i. in an implant capsule) *Target pests: Douglas-fir gall midge, coneworm*					
Implants	Individual trees in any Douglas-fir (Provolt), ponderosa pine (Sprague), and sugar pine production orchard unit	1 3-mL capsule/4 inches circumference at breast height 1 application to 1,000 trees on 75 acres (Provolt) 1 application to 1,000 trees on 50 acres (Sprague)	1 3-mL capsule/4 inches circumference at breast height 1 application to 1,700 trees on 110 acres (Provolt) 1 application to 2,000 trees on 73 acres (Sprague)	Jan - Mar	Annually, rotating among orchard units

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Permethrin: Pounce® 3.2 EC (38.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir cone worm, western conifer seed bug*					
High-pressure hydraulic sprayer	Individual trees in any production orchard unit	0.01 lb a.i./tree, in water at 5 gal/tree 2 applications to 1,700 trees (Provolt) 1 application to 500 trees (Sprague)	0.02 lb a.i./tree, in water at 10 gal/tree 2 applications to 1,700 trees (Provolt) 2 applications to 500 trees (Sprague)	May - Jul	As back-up or alternate to esfenvalerate
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard unit	0.002 lb a.i./tree, in water at 1 gal/tree 2 applications to 250 trees (Provolt) 1 application to 250 trees (Sprague)	0.006 lb a.i./tree, in water at 3 gal/tree 2 applications to 250 trees (Provolt) 2 applications to 500 trees (Sprague)	May - Jul	As back-up or alternate to esfenvalerate

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Potassium salts of fatty acids: Safer® Soap (49.52% a.i. as a liquid concentrate) *Target pests: mites, aphids, mites, webworms, sawfly larvae and similar caterpillars and worms causing foliar damage, including the larvae of cone and seed insects*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Administrative areas or isolated orchard areas such as sensitive treatment areas near waterways, property boundaries, private or public roads, or treatment buffer areas	2.5 fl. oz. a.i./tree, in water at 1 gal/tree 1 to 2 applications to 500 trees	4.0 to 8.0 fl. oz. a.i./tree, in water at 1 to 2 gal/tree 2 to 3 applications to 1,000 trees	Mar - Sep	Every 1 to 2 years as an alternate or supplement to non-chemical treatments
Propargite: Omite® CR (32% a.i. as a wettable powder in water soluble bags) *Target pests: spider mites*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard unit	1.4 lb a.i./acre, in water at 100 gal/acre 1 application to 250 trees (Provolt) 1 application to 600 trees on 4 acres (Sprague)	2.4 lb a.i./acre, in water at 100 gal/acre 2 applications to 550 trees (Provolt) 2 applications to 1,100 trees on 7 acres (Sprague)	Apr - Oct	1 to 2 times in a 10-year period

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Fungicide					
Chlorothalonil: Bravo® 500 (40.4% a.i. as a liquid concentrate) *Target pests: Douglas-fir Rhabdocline needle cast, Douglas-fir rust, Phomopsis canker, and possibly Swiss needle cast or other foliar diseases, conifer blights, and fungus diseases*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand (Provolt only)	Individual trees in any orchard unit, individual plants in special use areas	2.1 lb a.i./acre, in water at 100 gal/acre 2 applications to 250 trees (Provolt) 2 applications to 600 trees on 4 acres (Sprague)	4.2 lb a.i./acre, in water at 100 gal/acre 3 applications to 550 trees (Provolt) 3 applications to 1,100 trees on 7 acres (Sprague)	Feb – Jun	1 to 2 years in a 5-year period
Herbicides					
Dicamba: Banvel® (48.2% a.i. as a water-soluble liquid) *Target vegetation: annual, biennial, and perennial broadleaf weeds, woody brush and vines, as noxious weeds or competing vegetation and unwanted fuels*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot or strip treatments of weeds along fences, along roads, within orchard units, within open fields, or around facilities	1 lb a.i./treated acre, in water at 10 to 100 gal/acre 1 application to 3 acres	2 lb a.i./treated acre, in water at 10 to 100 gal/acre 2 applications to 5 acres	Apr – Jun	Back-up or alternate to glyphosate or for persistent weeds.
Tractor-pulled spray rig with fixed nozzles or small boom	Strip treatments along roads or fences	1 lb a.i./acre, in water at 10 to 100 gal/acre 2 applications to 3 acres (Provolt) 2 applications to 1 acre (Sprague)	2 lb a.i./acre, in water at 10 to 100 gal/acre 2 applications to 5 acres (Provolt) 2 applications to 2 acres (Sprague)	Mar – Jul (Provolt) Apr – Jul (Sprague)	

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Dicamba: Banvel® (48.2% a.i. as a water-soluble liquid) (continued) *Target vegetation: annual, biennial, and perennial broadleaf weeds, woody brush and vines, as noxious weeds or competing vegetation and unwanted fuels*					
Hand-held wick	Spot treatments in orchard units, open fields, near sensitive areas, near facilities, along fencelines and roadsides	24.1% a.i. solution wiped on individual weed plants 2 applications to weeds on 2 acres	24.1% a.i. solution wiped on individual weed plants 2 applications to weeds on 3 acres	Mar – Jul (Provolt) Apr – Jul (Sprague)	Back-up or alternate to glyphosate or for persistent weeds.
Glyphosate: Rodeo® (53.8% a.i. as isopropylamine salt; water-soluble liquid) *Target vegetation: blackberry, yellow star thistle, puncture vine, Canada thistle, spiny clotbur, Pacific poison oak, Scotch broom, bull thistle, and other noxious weeds, plus other competing vegetation or unwanted fuels vegetation*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot or strip treatments of weeds along fences, along roads, within orchard units, within open fields, or around facilities	4 lb a.i./acre, in water at 10 to 40 gal/acre 1 application to 3 acres	5 lb a.i./acre, in water at 10 to 40 gal/acre 2 applications to 5 acres	Apr – Aug	Initially 2-3 times per year. As plant populations diminish, spot applications 1 (Sprague) or 1-2 (Provolt) times per year to treat new invasions.
Tractor-pulled spray rig with fixed nozzles or small boom	Strip treatments along roads or fences	1 lb a.i./acre, in water at 50 to 100 gal/acre 1 application to 3 acres (Provolt) 1 application to 1 acre (Sprague)	4 lb a.i./acre, in water at 50 to 100 gal/acre 1 application to 5 acres (Provolt) 1 application to 2 acres (Sprague)	Apr – Aug	

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Glyphosate: Rodeo® (53.8% a.i. as isopropylamine salt; water-soluble liquid) (continued) *Target vegetation: blackberry, yellow star thistle, puncture vine, Canada thistle, spiny clotbur, Pacific poison oak, Scotch broom, bull thistle, and other noxious weeds, plus other competing vegetation or unwanted fuels vegetation*					
Hand-held wick	Spot treatments in orchard units, open fields, near sensitive areas, near facilities, along fencelines and roadsides	17.9 % a.i. solution wiped on individual weed plants 2 applications to weeds on 2 acres	17.9 % a.i. solution wiped on individual weed plants 2 applications to weeds on 3 acres	Apr - Aug	Initially 2-3 times per year. As plant populations diminish, spot applications 1 (Sprague) or 1-2 (Provolt) times per year to treat new invasions
Hexazinone: Velpar® (90% a.i. as a soluble powder) *Target vegetation: annual, biennial, and perennial broadleaf weeds, grasses, woody brush and vines, as noxious weeds or competing vegetation and unwanted fuels*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot or strip treatments of weeds along fences, along roads, within orchard units, within open fields, or around facilities	1 lb a.i./acre, in water at 25 to 100 gal/acre 1 application to 3 acres	7.2 lb a.i./acre, in water at 25 to 100 gal/acre 1 application to 5 acres	Apr - Jun	Used only as an alternate to other herbicides such as glyphosate, 1 to 2 times in a 10-year period

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Picloram: Tordon® 22K (24.4% a.i. as a liquid concentrate) *Target vegetation: annual, biennial, and perennial broadleaf weeds, woody brush and vines, as noxious weeds or competing vegetation and unwanted fuels*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot or strip treatments of weeds along fences, along roads, within orchard units, within open fields, or around facilities	0.25 lb a.i./acre, in water at 10 to 50 gal/acre 1 application to 3 acres	1 lb a.i./acre, in water at 10 to 50 gal/acre 2 applications (in two separate locations) to 5 acres per application	Apr - Jun	Primarily as an alternate to other chemicals for noxious weed control, especially spot treatments of persistent noxious weeds or other vegetation, 1 to 2 times in a 10-year period
Triclopyr: Garlon® 4 (61.6% as a liquid concentrate) *Target vegetation: annual, biennial, and perennial broadleaf weeds, woody brush and vines, as noxious weeds or competing vegetation and unwanted fuels*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot or strip treatments of weeds along fences, along roads, within orchard units, within open fields, or around facilities	1.5 lb a.i./acre, in water at 10 to 100 gal/acre 1 application to 3 acres	8 lb a.i./acre, in water at 10 to 100 gal/acre 2 applications to 5 acres	Apr - Jun	Primarily as an alternate to other chemicals for noxious weed control, especially spot treatments of persistent noxious weeds or other vegetation, 1 to 2 times in a 10-year period

Table 2.2-1. Pesticide and Fertilizer Application Summary[a] (continued)

Application Method	Location	Typical Application Rate and Area	Max Application Rate and Max Area	Application Date Range	Anticipated Frequency
Fertilizers					
Ammonium sulfate (21-0-0-24), ammonium phosphate (11-52-0), ammonium nitrate (34-0-0), or potassium nitrate (14-0-45)					
Broadcast spreader pulled by tractor or ATV	All orchards	175 lb/acre ammonium sulfate -plus- 175 (Provolt) or 110 (Sprague) lb/acre ammonium phosphate -plus- 20 (Provolt) or 25 (Sprague) lb/acre ammonium nitrate -plus- 35 (Provolt) or 25 (Sprague) lb/acre potassium nitrate 1 application to 120 acres starting on Feb 1 (Provolt) or 91 acres starting on Feb 15 (Sprague)	175 lb/acre ammonium sulfate -plus- 175 (Provolt) or 110 (Sprague) lb/acre ammonium phosphate -plus- 20 (Provolt) or 25 (Sprague) lb/acre ammonium nitrate -plus- 35 (Provolt) or 25 (Sprague) lb/acre potassium nitrate 1 application to 120 acres starting on Feb 1 (Provolt) or 91 acres starting on Feb 15 (Sprague)	Feb - Mar	Annual

[a] The formulations listed are those currently expected to be used. If other formulations of the same active ingredient are used, the application methods, locations, area, date range, frequency, and active ingredient application rates listed in this table would still apply.

Table 2.6-1. Summary of Potential Impacts by Alternative

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Air Quality	NS*	NS	NS	NS
Geological Resources	NS	NS	NS	NS
Water Resources	**Groundwater:** No significant impacts. Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts. Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts. Although the fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts if applications are as described under other alternatives. Pesticide and fertilizer chemicals could leach to groundwater, depending on project-specific details, limitations, and mitigations.
	Streams and Rivers: Runoff or drift from pesticide or fertilizer applications could enter surface water. (The effects of the estimated stream concentrations on human health and aquatic species are described under those headings.)	**Streams and Rivers:** No significant impacts from chemical, biological, prescribed fire, or cultural controls, since limitations to pesticide application would be implemented that control runoff and drift potential. Runoff containing fertilizers could enter surface water. (The effects of the estimated stream concentrations on human health and aquatic species are described under those headings.)	**Streams and Rivers:** No significant impacts from biological, prescribed fire, or cultural controls. Runoff containing fertilizers could enter surface water.	**Streams and Rivers:** Runoff or drift from pesticide or fertilizer applications could enter surface water, depending on the project-specific details, limitations, and mitigations. (The effects of the estimated stream concentrations on human health and aquatic species are described under those headings.)
	Accidents: Spill of pesticide or fertilizer could contaminate surface water or groundwater.	**Accidents:** Spill of pesticide or fertilizer could contaminate surface water or groundwater.	**Accidents:** Spill of fertilizer could contaminate surface water or groundwater.	**Accidents:** Spill of pesticide or fertilizer could contaminate surface water or groundwater.
Land Use	NS	NS	NS	NS

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Human Health and Safety	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing.	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing.	**Members of the Public:** NS	**Members of the Public:** No significant impact from use of any proposed control method, if used as described under any action alternative. Unknown risks if pesticides other than those included in this EIS are used. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing.
	Workers: Adverse health effects possible from some pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** No significant impact predicted from pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** Possible injuries from cultural or prescribed fire methods.	**Workers:** Adverse health effects possible from some pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Biological Resources	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS
	Terrestrial Wildlife: Possible risks to some birds, mammals, amphibians, and special status species under typical and maximum conditions (and reptiles under maximum conditions only) from three proposed insecticides. Non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire, or other methods.	**Terrestrial Wildlife:** Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire, or other methods.	**Terrestrial Wildlife:** NS	**Terrestrial Wildlife:** Possible risks to non-target wildlife, depending on project-specific details, limitations, and mitigations. Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire, or other methods.
	Aquatic Species: No significant risks from chemical, biological, prescribed fire, or cultural control methods. Risks to special status species from fertilizer in runoff at Sprague under maximum conditions only; no adverse impact predicted from fertilizers at Provolt. An accidental pesticide spill into a stream would have adverse effects on aquatic species.	**Aquatic Species:** No significant risks from chemical, biological, prescribed fire, or cultural control methods. Risks to special status species from fertilizer in runoff at Sprague under maximum conditions only; no adverse impact predicted from fertilizers at Provolt. An accidental pesticide spill into a stream would have adverse effects on aquatic species.	**Aquatic Species:** No significant risks from biological, prescribed fire, or cultural control methods. Risks to special status species from fertilizer in runoff at Sprague under maximum conditions only; no adverse impact predicted from fertilizers at Provolt.	**Aquatic Species:** No significant risks from use of chemical, biological, prescribed fire, or cultural control methods, if used as described under any action alternative. Risks to special status species from fertilizer in runoff at Sprague under maximum conditions only; no adverse impact predicted from fertilizers at Provolt. Accidental pesticide spill into a stream would impact aquatic species.
Noise	NS	NS	NS	NS
Cultural Resources	NS	NS	NS	NS
Socioeconomics and Environmental Justice	NS	NS	NS	NS

*NS = no significant impacts predicted; see Chapter 4 for details.

3.0 Affected Environment

3.1 Introduction

This chapter describes the relevant environment at the Provolt and Sprague Seed Orchards within the Medford District, providing baseline information to allow the evaluation of potential environmental impacts that could result from the proposed action or an alternative action. As stated in 40 CFR 1508.14, the human environment includes natural and physical resources and the relationship of people to those resources. The environmental baseline resources described in this chapter were selected after identifying the potential issues and concerns related to the proposed action and alternatives. The relevant resources are described in a sufficient level of detail to adequately support the impact analysis. Those resources which are potentially affected most significantly, such as human health and biological resources, are described in greatest detail. Those resources which are likely to be impacted least, such as cultural resources and noise, are described in lesser detail.

The following resources would not be affected and are therefore not described in this chapter, nor evaluated in Chapter 4, in accordance with 40 CFR 1502.15:

- Visual resources: No structures would be built or demolished, nor would there be any activities that would affect visual or aesthetic resources as a result of the proposed action or an alternative. The closest wilderness areas are the Kalmiopsis Wilderness Area, which is about 30 miles west of Provolt and 33 miles southwest of Sprague; the Red Buttes Wilderness Area, which is about 20 miles south of Provolt; the Sky Lakes Wilderness Area, which is about 50 miles northeast of Provolt and 60 miles east of Sprague; the Mountain Lakes Wilderness Area, which is about 55 miles northeast of Provolt and 70 miles east of Sprague; and the Wild Rogue Wilderness Area, which is about 25 miles west of Sprague. The Crater Lake National Park is 65 miles northeast of Provolt and 70 miles east of Sprague.

- Transportation: No construction vehicles would be involved with any action, nor would there be any changes to vehicular traffic near either Provolt or Sprague.

The chapter begins with a discussion of the resources that may be affected by the proposed action or an alternative. The order of resource description is based on introducing the physical environment (air, geology, and water), followed by land use, human health, biological resources, and the human environment (noise, cultural resources, socioeconomics, and environmental justice).

3.2 Air Resources

This section discusses the climate, meteorology, and regional air quality of the area around the Provolt and Sprague seed orchards.

3.2.1 Climate and Meteorology

Provolt is approximately 15 miles southeast of the city of Grants Pass and 25 miles west of the city of Medford. Elevations at the seed orchard range from about 1,140 feet at the northern edge to 1,200 feet at the southern edge. Sprague is located approximately ten miles northwest of Grants Pass and about 40 miles northwest of Medford. Elevations range from about 1,010 feet at the southeast corner to 1,100 feet at the northwest corner.

The orchards' geographical locations between the Pacific Ocean and Cascade Mountains result in a maritime west coast climate, featuring mild, wet winters and warm, dry summers. The average July temperature at Grants Pass is 69° F, the average January temperature is 39° F, and average annual precipitation is 31 inches. Most of the precipitation occurs between the months of November and March, consistent with the frequent Pacific storm patterns (see Table 3.2-1).

Precipitation during the spring and summer months is typically very light. Annual average relative humidity ranges from a high of about 92%, typically in early morning, to a low of 26%, typically in the early afternoon. Winds are predominantly from the north to northwest throughout the months of December through August and from the south from September through November. Table 3.2-2 presents wind speed data from the Medford Airport, 25 miles to the east; average wind speeds usually range from 3 to 5 miles per hour year round.

3.2.2 Regional Air Quality

The National Ambient Air Quality Standards (NAAQS), established by EPA and adopted by the ODEQ, define the maximum allowable concentrations of pollutants that may be reached but not exceeded within a given time period. Primary standards protect public health, and secondary standards protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Section 110 of the *Clean Air Act* requires states to develop air pollution regulations and control strategies to ensure that state air quality meets the NAAQS established by EPA. These

Table 3.2-1. Climate Characteristics[a]

Characteristic	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean temperature (° F)	39.3	43.4	47.0	50.7	56.8	63.1	69.2	69.0	62.9	53.9	44.0	38.5	53.2
Mean precipitation (in)	4.96	4.36	3.66	2.02	1.21	0.53	0.37	0.45	0.87	2.07	5.12	5.40	31.02
Average days with 0.5 or more inches of rain	3.4	3.1	2.1	1.1	0.4	0.2	0.1	0.2	0.5	1.6	3.3	3.5	19.6

[a]Data are for Grants Pass for the period of record 1971 - 2000 (Oregon Climate Service 2002a).

Table 3.2-2. Wind Characteristics[a]

Characteristic	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Prevailing direction[b]	N	N	N	NW	NW	NW	NW	NW	S	S	S	N
Average wind speed (mph)[c]	3.7	4.5	4.8	5.1	5.1	5.3	5.0	4.7	3.6	3.2	2.7	3.1
Percent occurrence of wind speeds for all directions:												
Calm	38.6	39.0	30.4	25.6	25.6	26.9	28.9	38.9	38.9	45.0	51.5	47.9
1-3 mph	21.3	21.5	17.1	17.6	16.2	14.2	13.4	15.4	16.1	16.2	16.4	16.7
4-7 mph	26.3	25.8	30.7	31.9	32.5	31.3	31.7	30.8	30.8	27.7	23.4	24.5
8-12 mph	7.8	7.9	12.8	16.4	16.8	18.2	17.6	10.8	10.8	8.1	5.2	7.0
> 12 mph	5.9	5.8	9.0	8.5	8.9	9.4	8.4	3.4	3.4	3.1	2.6	3.9

[a]Data are for the city of Medford for the period of record 1949 - 1958 (Oregon Climate Service 2002b).
[b]Highest total percentage per direction observed during month.
[c]Averaged for all directions observed per month.

ambient standards, established under Section 109 of the *Clean Air Act*, currently address six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), lead (Pb), particulate matter (PM), and sulfur dioxide (SO_2). Particulate matter is further regulated by size for particles smaller than 10 microns in diameter (PM_{10}). Exceeding the NAAQS concentration is referred to as "nonattainment" of the pollutant standard.

Table 3.2-3 presents the current NAAQS and the Oregon Ambient Air Quality Standards for the six criteria pollutants, along with regional air quality data for 2001, during which time all standards were met at the closest monitoring site to both Provolt and Sprague, in Grants Pass.

The *Clean Air Act* Amendments of 1970 established three Federal air quality control regions (AQCRs) in western Oregon. Provolt and Sprague seed orchards are located in the Southwest Oregon AQCR. Air quality throughout this region currently meets Federal standards. Areas within the Grants Pass Urban Growth Boundary (UGB) and the Medford-Ashland Air Quality Maintenance Area (AQMA) have previously been in nonattainment for PM_{10}, and areas with the Medford-Ashland UGB have been in nonattainment for CO; however, these areas have not exceeded the NAAQS for the last three years and are preparing maintenance plans. When EPA approves these plans,

Table 3.2-3. National and State Ambient Air Quality Standards and Data[a]

Pollutant	Averaging Time	Standard[b]			2001 Air Quality Data (ppm)
		Primary NAAQS	Secondary NAAQS	Oregon AAQS	
O_3	1 hr 8 hr[c]	0.12 ppm (235 $\mu g/m^3$) 0.08 ppm (157 $\mu g/m^3$)[c]	—	0.12 ppm —	0.090[e] 0.070[e]
CO	1 hr 8 hr	35 ppm (40 mg/m^3) 9 ppm (10 mg/m^3)	—	35 ppm 9 ppm	7.7 5.5
NO_2	Annual arithmetic mean	0.053 ppm (100 $\mu g/m^3$)	Same as primary NAAQS	0.053 ppm	ND[f]
SO_2	3 hr 24 hr Annual arithmetic mean	0.50 ppm (1,300 $\mu g/m^3$) 0.14 ppm (365 $\mu g/m^3$) —	— — 0.03 ppm (80 $\mu g/m^3$)	0.50 ppm 0.10 ppm 0.02 ppm	ND ND ND
PM_{10}	Annual arithmetic mean 24 hours	50 $\mu g/m^3$ 150 $\mu g/m^3$	Same as primary NAAQS	50 $\mu g/m^3$ 150 $\mu g/m^3$	16.1 55
$PM_{2.5}$[c]	Annual arithmetic mean[c] 24 hours[c]	15 $\mu g/m^3$[c] 65 $\mu g/m^3$[c]	Same as primary NAAQS	—	10.6 55
Pb	Quarterly	1.5 $\mu g/m^3$	Same as primary NAAQS	1.5 $\mu g/m^3$	0.02[g]

[a]40 CFR 50, OAR 340-202, ODEQ 2002a.
[b]mg/m3 — milligrams per cubic meter; µg/m3 — micrograms per cubic meter; ppm — parts per million.
[c]A 1999 Federal court ruling has blocked implementation of these standards; they are included for information purposes only at this time.
[d]Maximum reading from 2001 in Grants Pass.
[e]Data are for Medford; no data from Grants Pass available.
[f]ND = no data available.
[g]Data are for 1999 in Medford; no 2001 data or data from Grants Pass available.

these areas will be designated as maintenance areas. The Grants Pass Central Business District has been under a maintenance plan for CO since October 2000. Provolt is about eight miles southeast of the Grants Pass UGB, about 12 miles west of the Medford-Ashland AQMA, about 15 miles west of the Medford-Ashland UGB, and about nine miles southeast of the Grants Pass Central Business District. Sprague is about six miles northwest of the Grants Pass UGB, about 23 miles northwest of the Medford-Ashland AQMA, about 27 miles northwest of the Medford-Ashland UGB, and about seven miles northwest of the Grants Pass Central Business District. The seed orchards and their immediate areas are in attainment for all criteria pollutants; that is, the national primary and secondary standards are met.

3.3 Geological Resources

3.3.1 Provolt Seed Orchard

3.3.1.1 Physiography and Topography

Provolt Seed Orchard is located within the Klamath Mountains in the Western Oregon Interior Valleys Province, at the confluence of Williams Creek and the Applegate River on floodplains and an alluvial terrace. Slopes within the seed orchard range from nearly level to 4%, generally to the north. Elevations range from about 1,140 feet at the northern edge to 1,200 feet at the southern edge. Williams Creek and the Applegate River have cut a relatively flat valley about one mile wide in the vicinity of Provolt.

3.3.1.2 Geology

The Klamath Mountains were formed in a series of uplift and depositional events. Thick layers of sediment have been deposited in river valleys. This alluvium is about 250 feet thick near the Rogue and Applegate Rivers. Three geomorphic surfaces are present at Provolt. The Horseshoe Surface is composed of river channels, point bar deposits, and abandoned meanders on the lower floodplains. It is underlain by deposits of sand and gravel. The Eagle Point Surface is composed of channel deposits (sandy alluvium) on higher floodplains. Deposits of sand and gravel also underlie this surface. The Tou Velle Surface is situated on alluvial terraces, consisting of medium-textured deposits. The source material for all of these surfaces is volcanic rock from the Cascade Mountains and metamorphic (rock changed by heat and pressure) and granitic rock from the Klamath Mountains.

3.3.1.3 Soils

Soil is formed by physical and chemical processes that are determined by parent material (from which the soils are derived), climate, living organisms (plants, animals, and microorganisms), topography, and time. Hot, dry summers and cool, moist winters at Provolt result in a mixture of deciduous and conifer trees, shrubs, and grasses. A relatively high amount of organic material returns to the soil each year from leaves and the annual dieback of vegetation. The topographic position of these soils has resulted in well drained to excessively drained soils. These soils have been weathered from coarse alluvial deposits, and have a low clay content.

Six types of soil are present at Provolt: Banning loam, Camas gravelly sandy loam, Central Point sandy loam, Newburg fine sandy loam, Kerby loam, and Takilma cobbly loam (SCS 1983, 1993). The cation exchange capacity of each of these soils is in the range of 5 to 25 milliequivalents per 100 grams (meq/100 g), indicating that they contain smectite clay and low to moderate amounts of organic matter, which adsorbs pesticides and fertilizers and retards their movement through the soil. The following paragraphs

describe the soils identified on the seed orchard. Table 3.3-1 presents soil characteristics relevant to the environmental mobility of fertilizers and pesticides.

Banning loam is a somewhat poorly drained soil on alluvial fans and drainageways in the southern part of the seed orchard. A small portion of the planted area is composed of this soil. It formed in alluvium derived from metamorphic, granitic, and ultramafic (a type of volcanic rock) rock. Typically, the surface layer is a black loam about six inches thick. From 8 to 14 inches, the soil is black clay loam. The subsoil, from 14 to 50 inches is a very dark grayish brown clay loam. The substratum, to a depth of 60 inches or more, is dark grayish brown clay loam. Slopes range from 0 to 3%. The available water holding capacity is 0.13 to 0.20 inches of water per inch of soil. The effective rooting depth is limited to 12 to 36 inches by a seasonally high water table. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is very slight. Soil pH ranges from 6.1 to 7.3.

Camas gravelly sandy loam is a deep, excessively drained soil on floodplains in the northern parts of Provolt near the Applegate River. This area lies between the orchard units and the river. It formed in alluvium derived mainly from granitic rock, and altered

Table 3.3-1. Soils at the Provolt Seed Orchard

Soil Series	Depth (in.)	Permeability (in/hr)	Depth to Water Table (ft)	Runoff	Slope (%)	Organic Matter (%)	Clay (%)	Soil Sensitivity[1]
Banning	0 – 6	0.6 – 2.0	1 - 3 (winter), > 6 (summer)	slow	0 – 3	2 - 5	20 - 27	moderate
	6 – 60	0.2 – 0.6				0.1 - 2	27 - 35	
Camas	0 – 10	2 – 6	> 6	slow	0 – 3	1 - 3	5 - 10	moderate
	10 - 60	20 - 101				0 - 1	0 - 5	
Central Point	0 – 15	2 – 6	4 (winter), > 6 (summer)	slow	0 – 3	2 – 8	12 -18	moderate
	15 – 36	2 – 6				0.5 – 2	12 -18	
	36 – 60	2 – 6				0 - 0.5	8 - 13	
Newburg	0 – 15	2 – 6	> 6	slow	0 - 3	2 – 4	7 - 15	moderate
	15 – 24	2 – 6				0.5 – 1	5 - 15	
	24 – 61	6 – 20				0.2 – 1	2 - 10	
Kerby	0 – 7	0.6 – 2.0	>6	slow	0 - 3	1 – 3	15 - 27	moderate
	7 – 40	0.6 – 2.0				0.5 – 1	18 - 27	
	40 – 60	6 – 20				0.2 -0.5	5 - 15	
Takilma	0 – 6	2 – 6	> 6	slow	0 – 3	2 – 4	15 - 23	moderate
	6 – 18	2 – 6				1 - 3	18 - 30	
	18 – 60	6 – 20				0.2 – 1	10 - 18	

Sources: SCS 1983, SCS 1993, OSUES 1998.
[1]The Oregon State University Extension Service developed soil sensitivity ratings for groundwater contamination based on leaching characteristics (permeability, soil depth, depth to groundwater, annual precipitation, and runoff as compared to infiltration) and sorption potential (the amount of organic matter, and the cation exchange capacity) (OSUES 1998).

sedimentary and extrusive igneous rock (derived from lava). Typically, the surface layer is a very dark grayish brown gravelly sandy loam about 10 inches thick. Underlying this layer, to a depth of 60 inches, is brown to dark grayish brown very gravelly sand. Slopes range from 0 to 3%. Brief, occasional flooding occurs on this soil throughout the year. The available water holding capacity is 0.07 to 0.09 inches of water per inch of soil. The effective rooting depth of 12 to 24 inches is restricted by very gravelly sand. Runoff is slow, and the hazard of erosion by water is moderate. This soil is highly erodible by wind. Soil pH ranges from 5.6 to 7.3.

Central Point sandy loam is a deep, well-drained soil on low stream terraces and alluvial fans in the northern parts of Provolt near the Applegate River. This area is used for seed production trees and an arboretum. It formed in alluvium derived mainly from granitic and metamorphic rock. Typically, the surface layer is a very dark grayish brown and dark brown sandy loam about 15 inches thick. The subsoil is dark brown sandy loam about 21 inches thick. Underlying this layer, to a depth of 60 or more inches, is dark brown gravelly sandy loam. Slopes range from 0 to 3%. The available water holding capacity is 0.08 to 0.12 inches of water per inch of soil. The potential rooting depth is 60 inches or more, with an effective rooting depth of about 28 inches. Runoff is slow, and the hazard of erosion by water is slight. This soil is highly erodible by wind. The soil pH ranges from 5.6 to 7.3.

Newburg fine sandy loam is a deep, somewhat excessively drained soil on floodplains in the northern part of the seed orchard. A small part of this soil occurs in multiple use areas. It formed in alluvium derived from granitic rock, and from altered sedimentary and extrusive igneous rock. Typically, the surface layer is a dark brown fine sandy loam about 15 inches thick. Underlying this layer, to a depth of 60 or more inches, is dark yellowish brown sandy loam and fine sandy loam. Slopes range from 0 to 3%. The available water holding capacity is 0.09 to 0.15 inches of water per inch of soil. The rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion by water is moderate. This soil is highly erodible by wind. Soil pH ranges from 5.6 to 7.3.

Kerby loam is a deep, well-drained soil on low stream terraces in the northern and central parts of the orchard. These areas are used for seed production, an arboretum, and multiple uses. The majority of Provolt's seed production units are on this soil. It formed in alluvium of mixed origin. Typically, the surface layer is a dark brown loam about seven inches thick. The subsoil is brown loam about 33 inches thick. Underlying this layer, to a depth of 60 or more inches, is brown and very dark grayish brown extremely gravelly sandy loam and extremely gravelly sand. Slopes range from 0 to 3%. The available water holding capacity is 0.04 to 0.22 inches of water per inch of soil. The potential rooting depth is 60 inches or more, with an effective rooting depth of 28 inches. Runoff is slow, and the hazard of erosion by water is slight. This soil is slightly erodible by wind. Soil pH ranges from 5.6 to 6.5.

Takilma cobbly loam is a deep, well-drained soil on low stream terraces in the northern part of the seed orchard near the Applegate River. This soil is planted with trees used for seed production. It formed in cobbly alluvium derived from volcanic, sedimentary, and ultramafic rock. Typically, the surface layer is a dark brown cobbly loam about six inches thick. The subsoil is dark brown very cobbly loam about 12 inches thick. Underlying this layer, to a depth of 60 or more inches, is dark brown extremely cobbly sandy loam. Slopes range from 0 to 3%. The available water holding capacity is 0.03 to 0.14 inches of water per inch of soil. The rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of erosion by water is slight. This soil is very slightly erodible by wind. Soil pH ranges from 6.1 to 7.3.

3.3.2 Sprague Seed Orchard

3.3.2.1 Physiography and Topography

The Sprague Seed Orchard is located within the Klamath Mountains, on foot slopes and hills near Jump-off Joe Creek and its tributaries. Slopes within the seed orchard range from nearly level to 20%, generally to the south and east. Elevations range from about 1,010 feet at the southeast corner to 1,100 feet at the northwest corner. Several tributaries to Jump-off Joe Creek flow through the seed orchard. These streams have cut a gently sloping valley about ½ mile wide in the vicinity of Sprague.

3.3.2.2 Geology

As discussed in Section 3.3.1.2, the Klamath Mountains were formed in a series of uplift and depositional events. Thick layers of sediment from erosion of the mountains have been deposited in river valleys. Sprague is situated on slopes that are actively eroding, depositing sediment into Jump-off Joe Creek and its tributaries. Soils at the seed orchard are overly weathered granite, generally at a depth of 40 to 60 inches.

3.3.2.3 Soils

Warm, dry summers and cool, moist winters at Sprague result in a mixture of conifer and deciduous trees, shrubs, and grasses. A relatively high amount of organic material is returned to the soil each year from leaves and the annual dieback of vegetation. The topographic position of these soils has resulted in well-drained soils. Two types of soils have been identified at Sprague: Holland sandy loam and Manita loam (SCS 1983). The cation exchange capacity of each of these soils is in the range of 5 to 25 meq/100 g, indicating that they contain smectite clay and low to moderate amounts of organic matter, which adsorbs pesticides and fertilizers and retards their movement through the soil. Additional characteristics of these soils are summarized in Table 3.3-2 and described in the following paragraphs.

Table 3.3-2. Soils at the Sprague Seed Orchard

Soil Series	Depth (in)	Permeability (in/hr)	Depth to Water Table (ft)	Runoff	Slope (%)	Organic Matter (%)	Clay (%)	Soil Sensitivity[1]
Holland C	0 – 14	2.0 – 6.0	> 6	medium	7 – 12	2 – 6	10 - 18	moderate
	14 – 28	0.2 – 0.6				1.0 – 2.0	22 -30	
	28 - 49	0.6 – 2.0				0.5 – 1.0	15 -35	
Holland E	0 – 14	2.0 – 6.0	> 6	medium	20 – 35	2 – 6	10 -18	low
	14 – 28	0.2 – 0.6				1.0 – 2.0	22 - 30	
	28 - 49	0.6 – 2.0				0.5 – 1.0	15 -35	
Manita	0 – 11	0.6 – 2.0	> 6	slow	2 – 7	2 - 4	18 - 27	very low
	15 - 35	0.6 - 2.0				0.5 - 3	27 - 33	
	11– 50	0.2 – 0.6				0.5 - 2	35 - 45	

Sources: SCS 1983, OSUES 1998.
[1]The Oregon State University Extension Service developed soil sensitivity ratings for groundwater contamination based on leaching characteristics (permeability, soil depth, depth to groundwater, annual precipitation, and runoff as compared to infiltration) and sorption potential (the amount of organic matter, and the cation exchange capacity) (OSUES 1998).

Holland sandy loam is a deep, well-drained soil on hillsides in the majority of the seed orchard, and includes nearly all the managed lands. It formed in colluvium derived mainly from granite. Typically, the surface layer is a dark grayish brown sandy loam about eight inches thick. The upper 20 inches of the subsoil is brown sandy loam and yellowish red sandy clay loam. The next 21 inches is yellowish red and strong brown sandy loam. Weathered granite is found at about 49 inches and the depth to bedrock ranges from 40 to 60 inches. Slopes range from 2 to 35%. The available water holding capacity is 0.1 to 0.16 inches of water per inch of soil. This soil is droughty in the summer. The potential rooting depth is 40 to 60 inches, with an effective rooting depth of about 28 inches. Runoff is slow to rapid and the hazard of water erosion is high. The hazard of erosion by wind is very slight. The main limitations for tree growth are lack of adequate moisture during the growing season, the hazard of erosion, and compaction by equipment when the soil is wet. Soil pH ranges from 5.1 to 6.5. Seed production areas occur in this soil, particularly in the northern region of the orchard. Nearly half of the land with Holland soil is not currently managed for conifer seed production.

Manita loam is a deep, well-drained soil on fans and hills, which formed in colluvium derived mainly from altered sedimentary and extrusive igneous rock. At Sprague, this soil occurs mostly in the southeastern portion of the property. Typically, the surface layer is dark reddish brown loam about 11 inches thick. The upper nine inches of the subsurface is reddish brown clay loam and the lower 30 inches is reddish brown clay. Depth to weathered bedrock ranges from 40 to 60 inches and, in some cases, exceeds 60 inches. Slopes range from 2 to 7%. The available water holding capacity is 0.13 to 0.21 inches of water per inch of soil. The potential rooting depth is 40 to 60 inches, with an effective rooting depth of about 24 inches. Runoff is slow, and the hazard of erosion by water is slight. The hazard of erosion by wind is very slight. The main limitations for tree growth are lack of adequate moisture during the growing season and compaction of the soil by equipment when the soil is wet. However, the orchard does have irrigation. Soil pH ranges from 5.4 to 6.5. Seed production units occur on Manita soil, which is found mostly in the southeastern region of Sprague near the greenhouse and main office area.

3.4 Water Resources

Water is a key resource because it is influenced by, and in turn influences, activities and resources outside the seed orchards. Water also provides habitat for fish and aquatic animals, as well as plants and animals that use streamside and pondside areas. Water entering the seed orchards can be a source of pollutants, bringing in organisms that cause tree diseases or bringing in pesticide residues from other agricultural operations. There is also the potential for water to take pollutants out of the seed orchards.

3.4.1 Provolt Seed Orchard

The Provolt Seed Orchard is located in the Rogue River Basin at the confluence of the Applegate River and Williams Creek. Williams Creek flows near the western side of the seed orchard property and crosses through the property near the northern boundary. The orchard is located within Township 38 South, Range 4 West (Section 6) and Range 5 West (Sections 1 and 12).

3.4.1.1 Groundwater

There is no site-specific information on groundwater flow for the Provolt Seed Orchard, but it is assumed to flow northwest in the same direction as the river and land surface. The orchard does not cross any EPA- or state-designated sole source aquifers, wellhead protection areas, or groundwater management areas.

There are more than 50 domestic wells in residential areas surrounding the orchard. The static water level in these wells ranges from 1.5 to 80 feet, and the distance to "first water" ranged between 30 and 198 feet (OWRD 2002a). There are two production BLM wells on the Provolt Seed Orchard. One well is approximately 200 yards northwest of the office. It is a gallery well in a natural spring that serves as the main irrigation source for 15 orchard units. The water collection structures are 18 feet deep, static water level is four feet, and the flow rate is 300 gallons per minute (gal/min). Water from this well was analyzed in September 2000 for trace metals and anions (chloride, fluoride, nitrate nitrogen, and sulfate); no water quality problems were detected. Many of the analytes were not detected (at each analytical method's limit of detection) and none exceeded their respective maximum contaminant levels. The second well is located near the office and used for domestic purposes. This well was renovated in 1989. It is 85 feet deep with a static water level of 15 feet and a flow rate of 12 gal/min. The locations of these two wells are shown in Figure 3.4-1. There are also six shallow groundwater monitoring wells that were installed in 1992 in the southern portion of the orchard (Orchard Unit 14). These wells were installed to monitor groundwater levels in a wet area of the orchard.

Southwest Region staff of the Oregon Water Resources Department (OWRD) recently applied for Oregon Watershed Enhancement Board grant funds to assess the groundwater resources of the Williams Creek Basin. The assessment would assist efforts to reduce surface water diversions and eliminate fish passage barriers in the area. Williams Creek is a tributary to the Applegate River and is a priority for streamflow restoration (OWRD 2002b).

3.4.1.2 Surface Water

Provolt is in the Applegate River sub-basin of the Rogue River Basin, at the mouth of the Williams Creek watershed. The Lower Applegate River watershed is downstream of this confluence. There are several irrigation ditches and reservoirs on the property. Figure 3.4-1 provides a water resources map for the seed orchard. The following paragraphs provide hydrologic information pertaining to these water bodies.

The Applegate River flows along the northern boundary of the property. It is a Class I stream[1] with a drainage area of 483 square miles (350,330 acres). Average discharge is about 612 cubic feet per second (cfs) at Provolt, based on extrapolated flow data from U.S. Geological Survey (USGS) gaging station 14366000, five miles upstream near the town of Applegate. Flow has been regulated since 1980 by the Applegate Dam (gaging station 14361900 at Applegate Lake). A maximum discharge of 37,200 cfs occurred on January 15, 1974, and the minimum discharge (since filling of Applegate Lake) of 22 cfs occurred on July 21, 2001 (USGS 2002).

Williams Creek, another Class I stream, flows near the western side of the property and crosses through the property near the northern boundary, where it flows into the Applegate River. The Williams watershed has steep mountainous slopes and a flat valley floor. The creek at the mouth of the river is classified as a C4 in the Rosgen classification[2]. It has broad valleys, and low gradient, meandering channels, with a dominant bed material of gravel. The drainage area is 52,944 acres, and the average discharge is estimated to be 92.5 cfs, extrapolated from flow data from the USGS's Applegate gaging station.

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[1] A Class I stream is a body of water that provides habitat for fish. It is designated by ODFW, as indicated on maps produced by ODFW.
[2] The Rosgen classification system is a stream classification system based on a number of criteria associated with stream morphology. It is used for stream habitat preservation and erosion control. A classification of C4 indicates the following: single thread channel, slightly entrenched, moderate to high width/depth ratio (>12), moderate to high sinuosity (>12), slope range of -0.01 to 0.02, and channel material consisting of gravel.

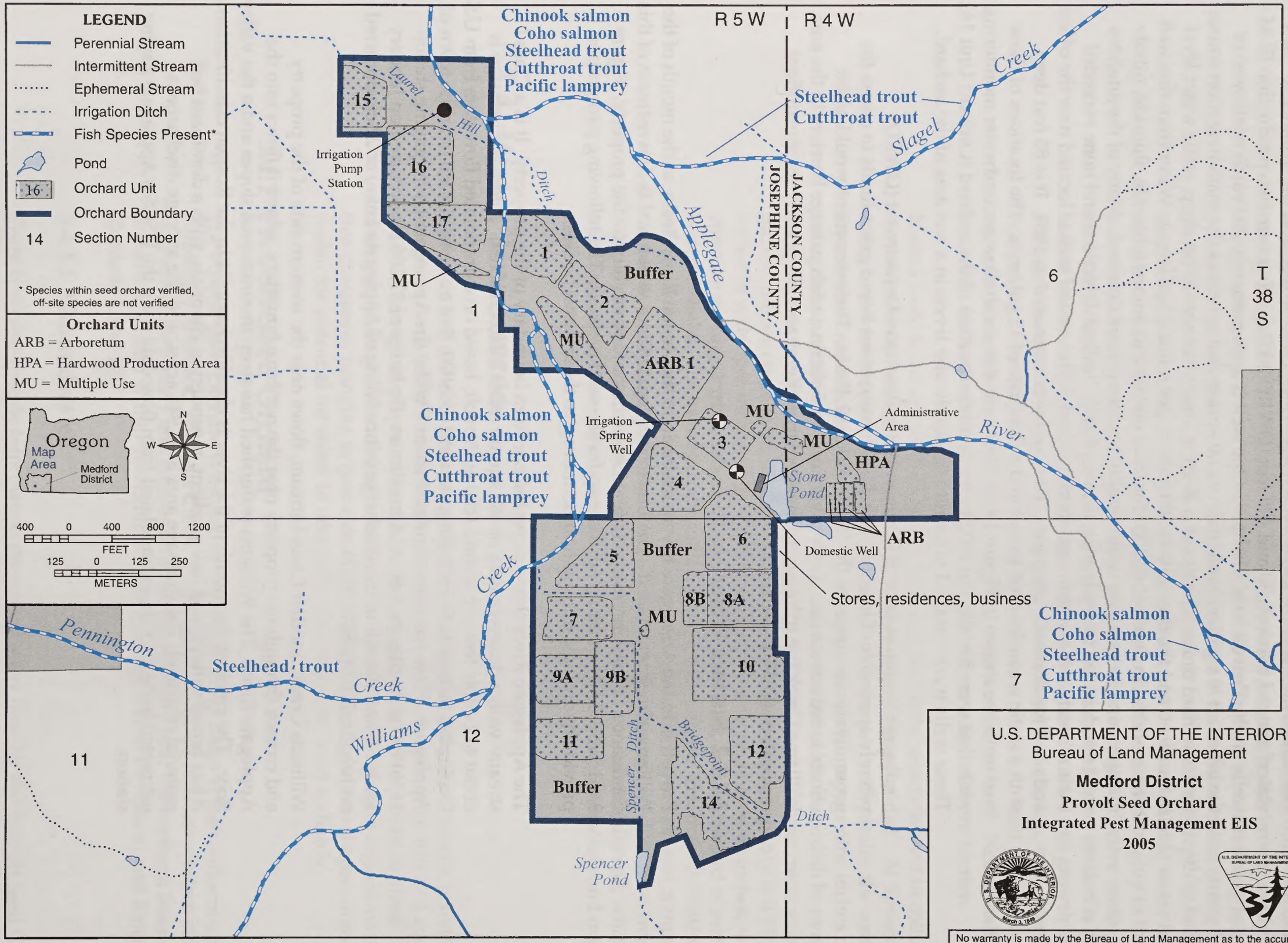

Figure 3.4-1: Surface Water Features at Provolt

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

Medford District
Provolt Seed Orchard
Integrated Pest Management EIS
2005

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The property contains three irrigation ditches and two small reservoirs. The Laurel Hill and Bridgepoint Ditch waters are both diverted from the Applegate River. The Laurel Hill Ditch starts near the northwestern portion of the property and flows across Williams Creek via a push-up dam. This ditch is used to irrigate three orchard units in the northwest portion of the property. The Bridgepoint Ditch originates from the Applegate River approximately five miles upstream from the orchard, near the town of Applegate. It flows into the orchard property at the southeast corner and flows northwest through the southern portion of the orchard until it crosses Williams Creek via a push-up dam and is diverted back into the ditch on the opposite bank. Bridgepoint Ditch provides water for Stone Reservoir via a control gate to an underground pipe. Stone Reservoir is located next to the orchard office and is an old farm pond that is only used for wildlife habitat. This pond has a volume of 4.5 acre-feet and has a control gate to manage outflows as needed. The outflow starts as a culvert and changes to a small ditch flowing east into the Applegate River.

Spencer Ditch, the third ditch, flows north through the southern part of the property where it joins the Bridgepoint Ditch. The southern area near Spencer Ditch is flooded in most wet winters from neighboring field and woodlot runoff; a bar ditch on the southwestern side of the property collects this water. Due to this flooding and a seasonally shallow water table, the southwestern orchard block, unit 13, is not planted now as an orchard unit but only as a cover crop.

There is another small reservoir located on the orchard property in the south-central part of the orchard that is the source of water for Spencer Ditch. This reservoir originates from runoff and from a small tributary from the southeast. The runoff is captured in a bar ditch along the side of the county highway, joins the tributary, and flows into a culvert under the road and into the reservoir. The reservoir holds two acre-feet and the outflow is managed by a control gate with boards leading to Spencer Ditch (see Figure 3.4-1).

Beneficial uses for the Rogue River Basin, as listed in the Oregon Administrative Rules (OAR 340-041-0362), include industrial and domestic water supplies, irrigation, and livestock watering; anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish, and aquatic life; wildlife and recreation (hunting, fishing, boating water contact recreation); aesthetic quality; and hydropower. The water rights on the Applegate River, as listed by OWRD, are irrigation, fish and wildlife, agriculture and industrial use (OWRD 2002c), with irrigation representing the majority of recorded beneficial uses in the vicinity of the orchard. The State of Oregon and Corps of Engineers water rights provide for irrigation water from the Applegate Reservoir and Applegate River through two Irrigation Ditch Company ditches. Over-allocation of water throughout the Williams Creek watershed during summer months has contributed to low stream flows, which cause sections of lower Williams Creek to dry up entirely during July and August (Williams Creek Watershed Council 2000).

The Applegate sub-basin and Applegate River are monitored at U.S. Highway 199. The Applegate River receives return flows from irrigated agriculture and other uses. During high flow periods, the river exhibits high levels of fecal coliforms and biochemical oxygen demand. During the low flow summer months, high temperature, concentrated total solids, and biochemical oxygen demand work to deplete dissolved oxygen concentrations. It appears that non-point source pollution is contributing to a significant decrease in water quality in the Applegate River (ODEQ undated). Williams Creek is periodically impaired by phosphate and moderately impaired by dissolved oxygen and nitrate (Williams Creek Watershed Council 2000).

Section 303(d) of the *Clean Water Act* requires states to list impaired water bodies and determine allowable total maximum daily loads that would provide for restoration of those impaired bodies. The list identifies those water bodies that do not meet all

applicable water quality standards necessary to protect beneficial uses. The 1998 ODEQ 303(d) list includes both the Applegate River and Williams Creek. The section of the Applegate River that flows past Provolt was listed for its high temperatures in the low flow summer months in 1998. Williams Creek was listed in 1998 for its high temperatures in the summer and in 2002 for dissolved oxygen (ODEQ 2002b). Beneficial uses that are potentially affected include salmonid fish rearing and anadromous fish passage in both Williams Creek and the Applegate River, and resident fish and aquatic life and salmonid fish spawning in the Applegate River.

There are no outstanding resource waters, national- or state-designated wild and scenic rivers, or public watershed areas found on the seed orchard.

3.4.1.3 Floodplains

Levels of the Applegate River are managed by the Applegate Dam, 26 miles upstream of the seed orchard, for flood control and irrigation. The Applegate River and Williams Creek have an extensive floodplain, which includes portions of Provolt (FEMA 2002). Orchard property is directly adjacent to Williams Creek and is also within its 100-year floodplain. Stream bank damage occurred during the New Year's Day 1997 flood downstream from the new State Highway 238 bridge. BLM designed and implemented stream bank stabilization using boulders and tree rootwads in the summer of 1999. The riverbed is now undergoing channel adjustments, especially at the orchard.

3.4.1.4 Drinking Water Sources

Groundwater is the primary source for drinking water in Oregon. It is also the primary source for public drinking water supplies in the seed orchard area. Other than the City of Grants Pass, which obtains its drinking water from surface water, all municipal public drinking water in the orchard vicinity is obtained from groundwater wells and springs (EPA 2002). There are no potable surface water intake structures in the vicinity of Provolt. No municipal water intake structures occur within the township in which the seed orchard is located.

3.4.2 Sprague Seed Orchard

The Sprague Seed Orchard is also located in the Rogue River basin in the Jump-off Joe Creek watershed, within Township 35 South, Range 6 West (Section 9).

3.4.2.1 Groundwater

There is some information on groundwater levels and quality collected over the past 25 years at Sprague. However, the orchard does not cross any EPA- or state-designated sole source aquifers, wellhead protection areas, or groundwater management areas. Groundwater movement is generally to the southeast in the winter months. Near the lake, groundwater flows to the northwest in the summer months. Winter groundwater flows are opposite to the land topography between the lake and the office.

The groundwater table throughout the orchard is extremely shallow during the wet season. Most of the land has been ripped, shallow ditches have been installed to provide surface drainage, and some developed portions of the orchard are not currently planted with conifers due to the seasonally high water table in the wet season.

Sprague is located in a rural residential area. There are a large number of domestic wells (more than 50) within the area of Section 9, including numerous wells to the immediate south, east, and north of the orchard. According to the well drilling logs, the average (static) water table depth is 30 to 40 feet, with a range of 5 to 70 feet (OWRD 2002d).

There are three wells on the seed orchard property (see Figure 3.4-2). "Well 1" is in the center of the orchard next to the reservoir. It pumps 90 gal/min and is used for irrigation and recharging the reservoir; maximum yield was 220 gal/min when first drilled in 1968 during a pump test. The well is 150 feet deep through granite soils. The static water table depth has typically been at approximately 15 feet, but was found at 10 feet in the spring of 1999 (OWRD 2002d, BLM 2002).

"Well 2" is in the southeast corner of the property, pumps approximately 35 gal/min, and provides water for domestic, irrigation, greenhouse nursery, and industrial use. In 1968, the static water level was 23 feet; in July 2000, it was measured by orchard staff at approximately 21 feet (BLM 2002). The well is 100 feet deep through granite.

"Well 3" is in the northwest corner, pumps 80 gal/min and is used for irrigation. The well was drilled through 150 feet of granite as well. In the spring of 1999, the water table was measured at 53 feet, although in other years it has been as shallow as 44.5 feet (BLM 2002). This well manifold has an outflow pipe to the riparian area of the stream next to it for maintenance purposes.

All three wells are believed to be in different sub-aquifers judging from the land structure's rises and depressions in elevation throughout the orchard.

Water quality testing of the domestic, irrigation, and monitoring well water was conducted in 1999 and 2000 for the presence of metals, inorganic substances, and organic compounds, including pesticides and herbicides. Test results revealed that none of these constituents were present in levels above maximum contaminant levels.

3.4.2.2 Surface Water

The Sprague Seed Orchard is in the Jump-off Joe Creek watershed. Jump-off Joe is a fifth-field watershed located in the Middle Rogue sub-basin. There are several small, unnamed tributaries and a small reservoir within the orchard boundaries. These waterways flow south and enter Jump-off Joe Creek 1.4 river miles below the property boundary. Approximately five miles downstream of this confluence, Jump-off Joe Creek enters the Rogue River. A water resources map for the orchard is provided in Figure 3.4-2.

Average discharge for Jump-off Joe Creek in the orchard vicinity is about 80 cfs, based on extrapolated flow data from USGS gaging station 14370600 near Pleasant Valley, about four miles upstream of the seed orchard. A maximum discharge of 13,520 cfs occurred on January 15, 1974. At times, there is no flow at all (OWRD undated).

The Sprague Seed Orchard totals 200 acres. It is divided into a northwestern and southeastern portion. The northwestern area occupies 160 acres, and all of the surface waterways are located there. These are all intermittent streams, which means they typically flow during the late fall, winter, and spring period of higher precipitation. The largest intermittent stream is on the western side of the property. It usually flows through early summer. The stream enters the property about 500 feet south of the northwest corner, and flows southeast down the western side of the property. This intermittent stream has a buffer of riparian vegetation approximately 40 to 60 feet on each side of the stream. There are several small natural drainages flowing into it. To the east, there are several other intermittent streams that flow only during storm events. These intermittent streams have a buffer of approximately 25 to 50 feet on each side of the stream portions. They flow south and join the larger stream just south of the property boundary.

On the eastern side, there are several more intermittent streams that flow seasonally. One of these flows south along the west side of the reservoir. The one in the easternmost

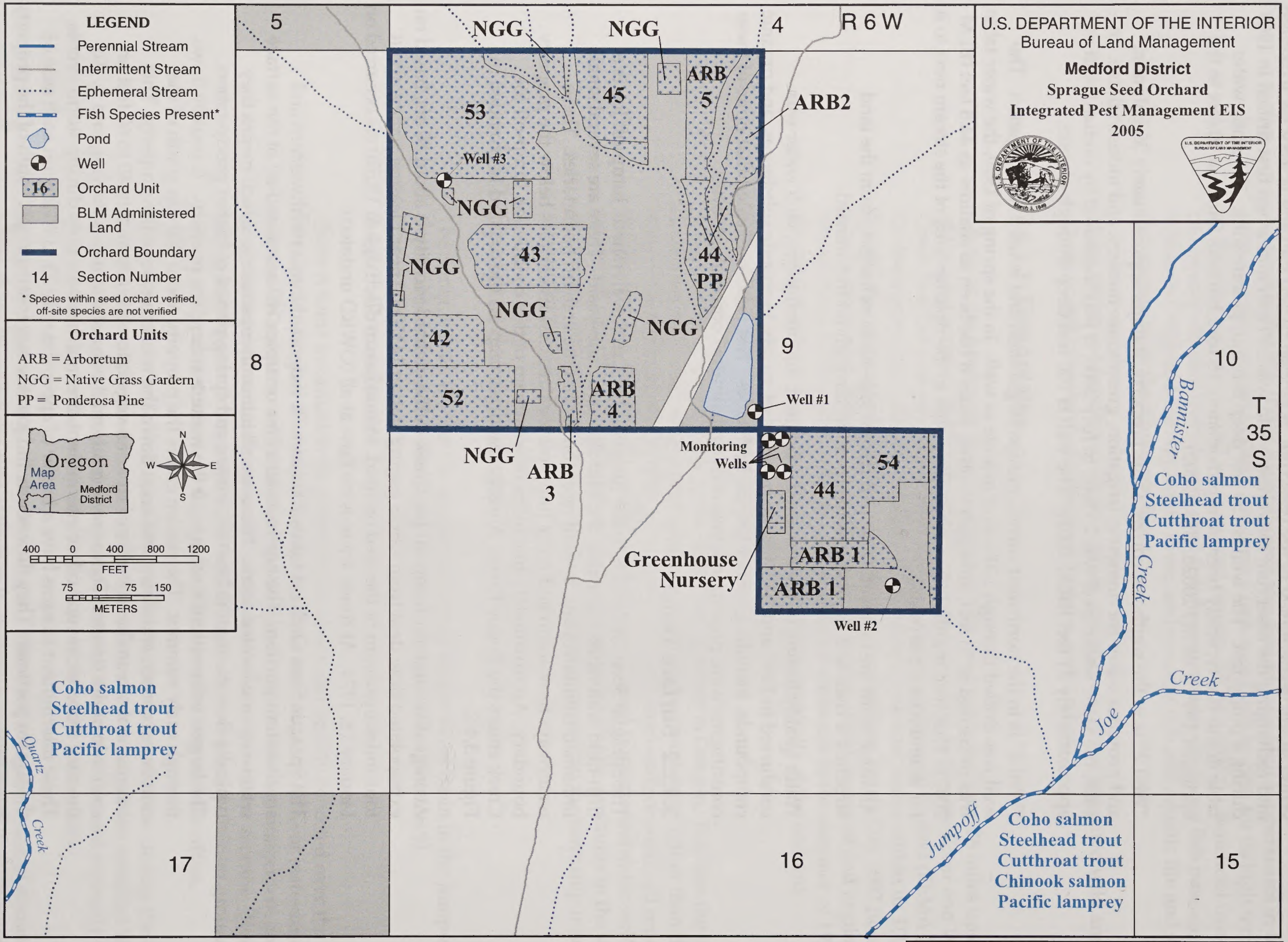


Figure 3.4-2: Surface Water Features at Sprague

corner is a wet area when it first enters the property. The water then flows into the stream and joins another stream to the south, where they cross the railroad tracks and flow into the reservoir from the northwest. These all have approximately 20- to 30-foot buffers on both sides. There is one other small intermittent stream that flows into the reservoir from the northeast, at the property boundary.

The orchard's reservoir, created in 1968 and called "Lake CASSO," is located in the southeast corner of the northern 160 acres. There are two inlets and one outlet. The outlet is a spillway that flows south, joining one of the intermittent streams and then flowing off the property. The reservoir has a surface area of 2.9 acres and a storage capacity of 16 acre-feet, with an average depth of six feet. The drainage area above the reservoir is 0.86 square mile (550 acres), and the water source is from two intermittent creeks and an orchard well ("Well 1"). An average of 0.15 acre-feet is lost per day by seepage. The reservoir has a sandy loam bottom and trees around its perimeter. It is used as a pump chance (wildfire water source) and for wildlife habitat. BLM has a water right for the reservoir. The water right is specified now for irrigation purposes, but a transfer application has been filed to change the irrigation right to multi-purpose uses. Lake CASSO was used for irrigation in the past; however, due to the presence of *Phytophthora* spp. and other root pathogens, it is no longer used for this purpose.

Beneficial uses for the Rogue River Basin, as listed in the Oregon Administrative Rules (OAR 340-041-0362), include industrial and domestic water supplies, irrigation, and livestock watering; anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish, and aquatic life; wildlife and recreation (hunting, fishing, boating water contact recreation); aesthetic quality; and hydropower. Irrigation represents the majority of recorded beneficial uses in the vicinity of the orchard.

Jump-off Joe Creek is on the ODEQ list of water quality limited streams under Section 303(d) of the *Clean Water Act*. It is listed for temperature both in 1998 and 2002. Beneficial uses that are potentially affected include salmonid fish spawning, salmonid fish rearing, and anadromous fish passage (ODEQ 2002c).

There are no outstanding resource waters, national- or state-designated wild and scenic rivers, or public watershed areas found on the orchard.

3.4.2.3 Floodplains

The Sprague Seed Orchard property is located well outside the 100-year floodplain for Jump-off Joe Creek.

3.4.2.4 Drinking Water

Groundwater is the primary source for drinking water in Oregon. It is also the primary source for public drinking water supplies in the seed orchard area. Other than the City of Grants Pass and Cave Junction, which obtain drinking water from surface water, all drinking water in Josephine County is obtained from groundwater wells and springs (EPA 2002). This includes the private residences located immediately adjacent to the orchard on Sugar Pine Drive. There are no potable surface water intake structures in the orchard vicinity.

3.5 Land Use

3.5.1 Provolt Seed Orchard

Provolt Seed Orchard is located in Josephine and Jackson Counties within a rural, generally agricultural area along a river bottom. Land uses in the surrounding area include farmland, residential acreages, woodlot riparian areas, Applegate River and Williams Creek riparian areas, a sand and gravel operation, and small towns or communities. Adjacent land uses are illustrated in Figure 3.5-1. There are approximately 12 residences and one church adjacent to or near the seed orchard boundary.

Jackson County borders California to the south and is surrounded by the Cascade and Siskiyou Mountain ranges. Centrally located along Interstate 5 between Portland and San Francisco, it is just hours from the Pacific Ocean coastline. The scenery, moderate weather, and other attractions bring both tourists and a growing retirement population to the area. Once known primarily for timber, this area now reflects a more service-oriented economic base, focused on health care, retail, and tourism, although agriculture, manufacturing, and timber continue to be factors in the region. More than 50% of the county's land is owned by the Federal government and managed by BLM, the Forest Service, and other agencies (OED 2002, JaCO 2002).

Josephine County, once heavily dependent upon natural resource-based industries such as agriculture and wood products, is also undergoing substantial change while maintaining its rural character. Now, retirement and other service-based sectors are increasing in importance, although farming, wood processing, lumber products, and landscaping materials continue to be significant components of the local economy. The area is near the California border and is accessible via U.S. Highway 199 and Interstate 5 to major population centers to the north and south, fueling growth in tourism linked to the Rogue River and other recreational attractions such as the Oregon Caves National Monument. Tourist services include rafting rentals, fishing, jet boat rides, camping, lodging, fuel, and restaurants (OED 2002, JoCO 2002).

The two counties share some similarities, but are quite different in their densities and urban-rural composition. Josephine County is much less densely settled, with a population density of 46.2 persons per square mile compared to Jackson County's 65.1 (USBC 2002a). In Josephine County, only 52% of residents are urban, and all of the county's urban population is within "urban clusters," or smaller communities.[3] Of the county's rural residents, only 2% reside on farms, a much lower proportion than for the comparison areas. In Jackson County, 78% percent of residents are considered urban, which is comparable to Oregon and the U.S. Jackson County's urban population is more concentrated within "urban areas," and a higher proportion of its rural population resides on farms than is the case in Josephine County. Table 3.5-1 presents urban and rural characteristics for the two counties, Oregon, and the U.S.

Provolt Seed Orchard is located in Township 38 South, Range 5 West, Sections 1 and 12, and in Township 38 South, Range 4 West, Section 6. Most of the lands surrounding the orchard boundary are privately owned. Nearby farming activities include dairy production, hay crops, cattle grazing, and vegetable production.

[3] The U.S. Bureau of the Census divides "densely settled territory" into urbanized areas and urbanized clusters. "Densely settled territory" is defined as a cluster of one or more block groups or census blocks, each with a population density of at least 1,000 people per square mile, or the surrounding block groups and census blocks, each with a population density of at least 500 people per square mile. Urban areas contain 50,000 or more people, while urban clusters contain between 2,500 and 50,000 people (USBC 2002b).

Figure 3.5-1: Adjacent Land Uses at Provolt

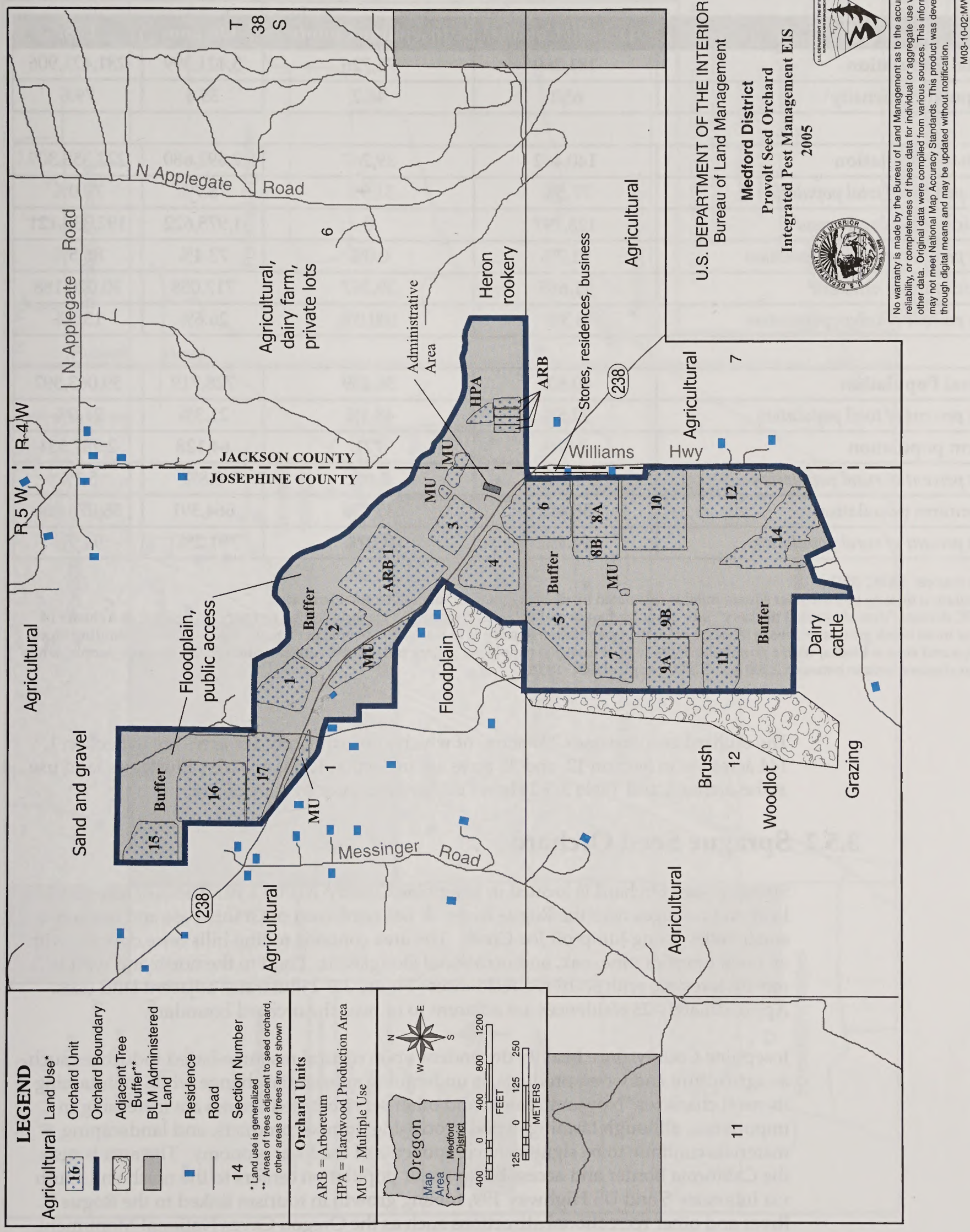


Table 3.5-1. Urban and Rural Characteristics, Counties and Comparison Areas

	Jackson County	Josephine County	Oregon	U.S.
Total Population	181,269	75,726	3,421,399	281,421,906
Population density[1]	65.1	46.2	35.6	79.6
Urban Population	140,462	39,267	2,692,680	222,358,309
as percent of total population	77.5%	51.9%	78.7%	79.0%
Inside urbanized areas[2]	128,797	0	1,975,622	192,338,121
as percent of urban population	91.7%	0.0%	73.4%	86.5%
Inside urban clusters[2]	11,665	39,267	717,058	30,020,188
as percent of urban population	8.3%	100.0%	26.6%	13.5%
Rural Population	40,807	36,459	728,719	59,063,597
as percent of total population	22.5%	48.1%	21.3%	21.0%
Farm population	2,389	721	64,128	2,987,531
as percent of rural population	5.9%	2.0%	8.8%	5.1%
Nonfarm population	38,418	35,738	664,591	56,076,066
as percent of rural population	94.1%	98.0%	91.2%	94.9%

Data source: USBC 2002a.
[1]Population density (persons per square mile) is calculated by dividing total population by total land area.
[2]USBC divides "densely settled territory" into urbanized areas and urbanized clusters. "Densely settled territory" is defined as a cluster of one or more block groups or census blocks, each with a population density of at least 1,000 people per square mile, or the surrounding block groups and census blocks, with a population density of at least 500 people per square mile. Urban areas contain 50,000 or more people, while urban clusters contain between 2,500 and 50,000 people (USBC 2002b).

The orchard encompasses 294 acres, of which approximately 117 acres are in Section 1, 144 acres are in Section 12, and 33 acres are in Section 6. Figure 2.1-1 illustrates land use at the orchard, and Table 3.5-2 shows orchard acreages by type of use.

3.5.2 Sprague Seed Orchard

Sprague Seed Orchard is located in Josephine County, within a rural area of forested land and acreages near the Rogue River. It lies northwest of Grants Pass and borders a small valley along Jump-off Joe Creek. The area contains rolling hills once covered with an open forest of pine, oak, and occasional Douglas-fir. Land to the north and west is mostly forested, with scattered residences. Figure 3.5-2 illustrates adjacent land uses. Approximately 23 residences are adjacent to or near the orchard boundary.

Josephine County, once heavily dependent upon natural resource-based industries such as agriculture and wood products, is undergoing substantial change while maintaining its rural character. Now, retirement and other service-based sectors are increasing in importance, although farming, wood processing, lumber products, and landscaping materials continue to be significant components of the local economy. The area is near the California border and accessible to major population centers to the north and south via Interstate 5 and US Highway 199, fueling growth in tourism linked to the Rogue River and other recreational attractions such as the Oregon Caves National Monument. Tourist services include rafting rentals, fishing, jet boat rides, camping, lodging, fuel, and restaurants (OED 2002).

Figure 3.5-2: Adjacent Land Uses at Sprague

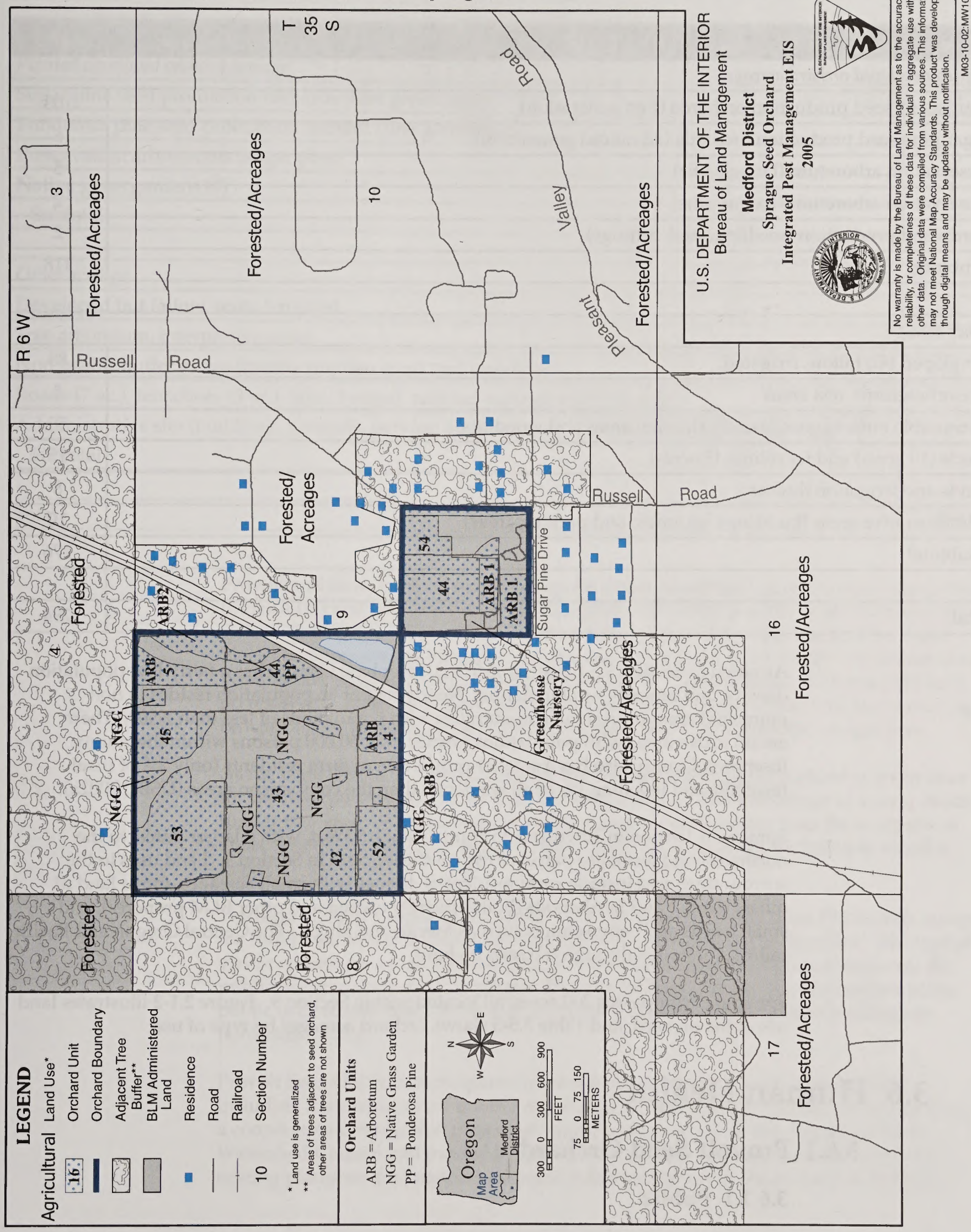


Table 3.5-2. Provolt Seed Orchard Land Use

Description	Acres
Planted developed orchard acreage	
Douglas-fir seed production orchards (first generation)	103
Sugar pine seed production orchards (advanced generation)	6
Preservation arboretum (Douglas-fir)	5
Preservation arboretums (sugar pine)	2
Hardwood production (seedlings and cuttings)	2
Subtotal	118
Other acreage	
Developed but fallow, irrigated	88
Tree arboretums, test areas	5
Non-usable buffer zones (mostly riparian areas and woodlots)	50
Roads (10 acres) and fencelines (5 acres)	15
Ponds and irrigation ditches	8
Administrative areas (buildings, grounds, and parking areas)	10
Subtotal	176
Total	294

As noted in Section 3.5.1 (see Table 3.5-1), Josephine County has a fairly low population density, and remains rural in nature. Nearly half of its population resides in non-municipal areas or in small communities with populations of less than 2,500. There are no urban areas with populations greater than 50,000 persons within the county. Josephine County also has a smaller proportion of farm residents (only 2% of rural residents and less than 1% of all residents) than the comparison areas (USBC 2002a).

Sprague is located in Township 35 South, Range 6 West, with a larger parcel to the northwest and a smaller parcel to the southeast, both in Section 9. Land uses in the surrounding area include rural residential, homes with small acreages, forest land of mixed conifer and hardwoods (both privately owned and other BLM property), and small towns and communities such as Merlin and Hugo. The Central Oregon and Pacific railroad line runs through the seed orchard.

Sprague encompasses 200 acres, all located within Section 9. Figure 2.1-2 illustrates land use at the orchard, and Table 3.5-3 shows orchard acreages by type of use.

3.6 Human Health

3.6.1 Provolt Seed Orchard

3.6.1.1 Public

The Provolt Seed Orchard is located in a rural area with little nearby development and few close neighbors. Aerial photographs were examined to determine approximate distances to nearby residences (BLM 1997). There are about 12 residences adjacent to the orchard boundary. Figure 3.5-1 illustrates the surrounding land uses.

Table 3.5-3. Sprague Seed Orchard Land Use

Description	Acres
Planted developed orchard acreage	
Sugar pine seed production orchards (first generation)	69
Ponderosa pine seed production orchard (first generation)	4
Preservation arboretums (sugar pine)	19
Native grass gardens (9)	3
Subtotal	95
Other acreage	
Developed but fallow, some irrigated	40
Tree arboretum, interpretive areas	3
Non-usable buffer zones (mostly riparian areas and woodlots)	24
Roads (7 ac.), fencelines (3 ac.), lake (3 acres), railroad right-of-way (5 acres)	18
Administrative site (buildings, grounds, parking areas, nursery complex, and wastewater area)	20
Subtotal	105
Total	200

Provolt and its immediate surroundings lie within Josephine County Census Tracts 3613 (Block 4037) and 3614 (Blocks 1000, 1023, 1024, 1025, 1026, and 1027), and Jackson County Census Tract 30.02 (Blocks 2012 and 2015).[4] Population data were assessed for these blocks to determine population numbers near the orchard and identify any sensitive sub-populations, such as young children or the elderly. Census Blocks 1024 and 2015 have no residents. Table 3.6-1 shows relevant demographic characteristics for the remaining census blocks (in total), along with county, state, and U.S. figures for comparison.

As the table shows, the median age for the area surrounding the orchard is lower than for the two counties but higher than the state and U.S. The percentage of young children (under five years of age) and older children (ages 5-14) is higher than the comparison areas, while the percentage of teens (ages 15-19) and the elderly (age 65 and older) is lower.

The seed orchard is open to the public Monday through Friday from 7:30 to 4:00, except for Federal holidays. Visitors are required to check in and out at the office. The typical visitor is there on an educational tour, to visit an educational display, or to access the public use areas along the Applegate River or Williams Creek. A few members of the public use orchard lands at Provolt for jogging, mountain biking, bird banding, or horseback riding.

Provolt Seed Orchard participates in several special projects with other entities, including a cooperative air quality monitoring project with ODEQ and other agencies, a cooperative propagation project for native hardwoods with the Applegate River Watershed Council and funded by grants from various sources, a project to provide nesting platforms for ospreys and perch poles for raptors in the orchard with Pacific

[4] The USBC divides counties into census tracts, which are subdivided into block groups, which are further subdivided into census blocks. The relative geographic size of these units is determined by their population; the greater the population, the more subdivisions each unit will have, and hence the subdivisions will be relatively smaller. The USBC attempts to divide a county in such a manner that sub-units within a larger unit will have approximately similar populations; however, migration in and out of an area will affect this balance over time and can result in "empty" census blocks.

Table 3.6-1. Selected Demographic Characteristics, Provolt Seed Orchard

	Total for Adjacent Blocks[1]	Jackson County	Josephine County	Oregon	U.S.
Total population	219	1,181,269	75,726	3,421,399	281,421,906
Total households	78	71,532	31,000	1,333,723	105,480,101
Median age[2]	38.7	39.2	43.1	36.3	35.3
Age distribution					
Under 5 years	9.1%	6.0%	5.3%	6.5%	6.8%
5 To 14 years	17.4%	14.0%	13.5%	13.9%	14.6%
15 To 19 years	3.2%	7.2%	6.5%	7.1%	7.2%
20 To 44 years	29.7%	31.5%	27.3%	35.9%	37.0%
45 To 64 years	30.6%	25.4%	27.2%	23.7%	22.0%
Over 65 years	10.0%	16.0%	20.1%	12.8%	12.4%

Data source: USBC 2002a.
[1]Josephine County Census Tracts 3613 (Block 4037) and 3614 (Blocks 1000, 1023, 1024, 1025, 1026, 1027), and Jackson County Census Tract 30.02 (Blocks 2012 and 2015).
[2]Median age for the combined "Adjacent Blocks" is estimated using a weighted average technique.

Power, and Eagle Scout projects to provide bat houses and birdhouses for the orchard. These programs include the use of a few volunteers, who spend an average of 20 to 40 hours per year at the orchard; hours vary by season and activity. The Audubon Society uses the cottonwood riparian areas along the Applegate River for netting and banding neotropical migrants as part of an international study effort for these species. This effort involves a total of about 140 to 160 hours per year, including 15 to 20 hours per month during spring and fall migration periods and 7 to 10 hours per month during the remainder of the year.

In addition, the orchard provides training opportunities for Jackson County minimum security inmates, student interns, and other volunteers. The inmates perform a variety of horticultural activities. The composition of inmate labor teams varies according to orchard labor needs at the time and inmate availability, and few inmates work regularly at the orchard for more than a few months at a time. In 2001, Jackson County inmates spent 200 hours at the seed orchard.

An ongoing program includes participation in Experience International, a training program that allows students from outside the U.S. to work at the seed orchard and its greenhouse to learn horticultural practices and orchard management. Provolt currently has no one from this program but expects to have participants again in the future.

Provolt Seed Orchard has an active public outreach program, which includes a display of native conifers, visits to local schools, and educational tours of the seed orchard featuring demonstrations on orchard, forestry, wildlife, and fisheries topics. The orchard lands near the Applegate River and Williams Creek also provide public access to the Applegate River for fishing, birdwatching, hiking, and other recreational activities. Provolt also allows collection of a variety of forest products, mainly firewood and boughs, by the general public each year. Permittees are restricted to collection during normal business hours.

3.6.1.2 Workers

Provolt has 3.5 full-time workers (the orchard manager divides his time between Provolt and the Sprague Seed Orchard). Full-time employees work 40 hours per week year-round; workers may follow flex-time schedules to complete 40 hours in less than five days within a given period. Provolt has no part-time or seasonal workers. The length of orchard employment for Provolt's current employees ranges from 2 to 15 years.

3.6.2 Sprague Seed Orchard

3.6.2.1 Public

The Sprague Seed Orchard is located in a rural area with some nearby development and close neighbors. Aerial photographs were examined to determine approximate distances to nearby residences (NRCS 2002). There are about 23 residences nearby, ranging in distance from approximately 55 to 690 feet from the orchard boundary. Figure 3.5-2 illustrates the surrounding land uses.

Sprague and its immediate surroundings lie within Josephine County Census Tract 3603 (Blocks 2001, 2002, 2017, and 3008). Population data were assessed for these blocks to determine population near the orchard and identify any sensitive sub-populations, such as young children or the elderly. Table 3.6-2 shows relevant demographic characteristics for the census blocks (in total), along with county, state, and U.S. figures for comparison.

As the table shows, the median age for the area surrounding the orchard is substantially higher than the comparison areas. The percentage of the elderly (over age 65) is lower than the county's proportion, but substantially higher than the state and U.S., while the percentage of young children (under age five) and teens (aged 15-19) is lower. The percentage of older children is slightly higher than the county and state percentages, but slightly lower than the U.S. proportion.

Table 3.6-2. Selected Demographic Characteristics, Sprague Seed Orchard

	Total for Adjacent Blocks[1]	Josephine County	Oregon	U.S.
Total population	742	75,726	3,421,399	281,421,906
Total households	285	31,000	1,333,723	105,480,101
Median age[2]	47.3	43.1	36.3	35.3
Age distribution				
Under 5 years	3.9%	5.3%	6.5%	6.8%
5 To 14 years	14.3%	13.5%	13.9%	14.6%
15 To 19 years	5.4%	6.5%	7.1%	7.2%
20 To 44 years	21.3%	27.3%	35.9%	37.0%
45 To 64 years	36.5%	27.2%	23.7%	22.0%
Over 65 years	18.6%	20.1%	12.8%	12.4%

Data source: USBC 2002a.
[1]Census Tract 3603 (Blocks 2001, 2002, 2017, and 3008).
[2]Median age for the combined "Adjacent Blocks" is estimated using a weighted average technique.

Sprague is open to the public Monday through Friday from 7:30 to 4:00, except for Federal holidays. Visitors are required to check in and out at the office. The typical visitor is there on an educational tour or to visit an educational display. A few members of the public use orchard lands at Sprague for jogging, mountain biking, or horseback riding.

Like Provolt, Sprague participates in special projects, including those in which several types of volunteers spend an average of four to eight hours per month at the seed orchard. One volunteer is a retired BLM employee who builds and installs birdhouses as part of insect control. Audubon Society volunteers monitor 30 birdhouses throughout the year. Sprague hosts training, sponsored by the Institute for Bird Populations, for volunteers who net and band neotropical migrant birds; this involves approximately 20 people for a two-week period once a year. Sprague is also participating in a trial project with Bat Conservation International and other cooperators to monitor the use of bat boxes, mostly placed near water bodies.

In addition, the seed orchard provides training opportunities for Josephine County minimum security inmates, student interns, and other volunteer workers. The inmates perform a variety of horticultural activities. The composition of inmate labor teams varies according to orchard labor needs at the time and inmate availability, and few inmates work regularly at the orchard for more than a few months at a time. In 2001 and 2002, Josephine County inmates spent an average of 1,100 hours annually at Sprague. Students from Rogue Community College in Grants Pass have served as horticultural interns at various times, and a trainee from the Josephine County Job Council worked 500 hours in the greenhouse over the past year. One member of the public provides about 60 hours of volunteer labor per year. An ongoing program includes participation in Experience International, a training program that allows students from outside the U.S. to work at the seed orchard and its greenhouse to learn horticultural practices and orchard management. Sprague currently has no one from this program but expects to have participants again in the future.

Sprague sometimes hosts training events for a variety of organizations. Two examples include dog training for the Josephine County Search and Rescue Team, and training on unused portions of the orchard property for ATV operation for BLM employees. This type of activity occurs a few times per year.

Sprague also has a "host" volunteer agreement with an individual who is employed by a local law enforcement agency. This person is allowed to live on the orchard property in return for providing security when the seed orchard is closed. He resides year-round in his own trailer on a lot provided by Sprague.

Sprague has an active public outreach program, which includes a display of native conifers, visits to local schools, and educational tours featuring demonstrations on orchard, forestry, wildlife, and fisheries topics. Sprague also allows collection of a variety of forest products, mainly firewood and boughs, by the general public each year. Permittees are restricted to collection during normal business hours. In 2002, Sprague hosted over 2,000 wildland fire fighters in a fire camp for three weeks for the Biscuit Fire.

3.6.2.2 Workers

Sprague has 3.5 full-time and 2 part-time workers (as noted in Section 3.6.1.2, the seed orchard manager divides his time between Sprague and Provolt). Full-time employees work 40 hours per week year-round; workers may follow flex-time schedules to complete 40 hours in less than five days within a given period. The two part-time employees, both gardeners, are permanent and work 32 hours per week (Monday through Thursday) all year. Sprague has no seasonal employees. The length of orchard employment for Sprague's current employees ranges from 11 to 15 years.

3.7 Biological Resources

The following sections describe the vegetation, terrestrial wildlife, and aquatic species found at and near the Provolt and Sprague Seed Orchards. In addition to the abundant or common species observed, several species present or potentially present at Provolt or Sprague have a special status under Federal or state laws or recommendations.

The Federal ESA applies to all actions on all lands, whether they are undertaken by Federal agencies, state agencies, commercial entities, or private individuals. Species of concern are designated by the Oregon state office of FWS. These species receive no legal protection. Many species of concern are former Category 2 species that were candidates for listing under the ESA until 1996. Category 2 candidate species were those species for which information indicated that a proposal to list the species as endangered or threatened was possibly appropriate, but sufficient data on biological vulnerability and threats were not available to support proposed rules.

The Oregon *Threatened and Endangered Species Act* applies only to actions of state agencies on state-owned or leased lands, and therefore its regulatory scope does not extend to the proposed activities at the seed orchards. However, these species are evaluated as special status species in this EIS. ODFW also maintains a "watchlist" of sensitive species that might qualify for state listing in the future. These species may be designated as critical, vulnerable, peripheral or naturally rare, or of undetermined status.

BLM has three designations that may be applied to particular species. "Bureau Sensitive" species include species that could easily become endangered or extinct in a state, and are not listed, proposed, or candidate species under Federal laws, but are eligible. "Bureau Assessment" species are plant or animal species that are not presently eligible for official Federal or state status but are of concern. "Bureau Tracking" species act as an early warning for species which may become of concern in the future; BLM districts are encouraged to collect information on these species, but they are not considered special status species for management purposes. The State of Oregon has state-listed species, and these are on the BLM special status species list, as "State Listed."

3.7.1 Provolt Seed Orchard

Several species present or potentially present at Provolt have a special status under Federal or state laws or recommendations. These species include four birds, two reptiles, and five fish, as listed in Table 3.7-1.

Special status species are described within the appropriate sub-section below.

3.7.1.1 Vegetation

Orchard Areas

The Provolt Seed Orchard is a conifer plantation for the seed production of Douglas-fir. Aside from the stands of managed Douglas-fir, most of the remaining vegetation consists of introduced pasture grasses and weedy species. Dominant perennial pasture grasses include orchard grass, timothy, tall fescue, and Kentucky bluegrass. Introduced annual grasses include bromes, wild oats, wild barley, hedgehog dogtail, and bulbous bluegrass. A few scattered native trees can also be found in the seed orchard area, including ponderosa pine, incense cedar, and Oregon white oak.

Table 3.7-1. Special Status Species At or Near Provolt

Species	Federal Status	State Status	Orchard Occurrence
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Threatened	Occasionally forage along Applegate River near the orchard during nesting season or in winter months. Nearest known nests are two miles and 19 miles downstream, and 19 miles upstream at Applegate Lake. Use of orchard land sporadic and outside production area of the orchard.
Northern spotted owl (*Strix occidentalis caurina*)	Threatened	Threatened	Never documented at the orchard. Dispersing single owls may pass through or overnight occasionally in orchard woodlots or riparian areas. Nearest owl nest site is 3½ miles west of orchard.
Coho salmon (*Oncorhynchus kisutch*)	Threatened	Sensitive-critical	Seasonally found in Applegate River and Williams Creek within orchard boundary and outside production areas.
Cutthroat trout (*Oncorhyncus clarki clarki*)	Species of concern (FWS)	Sensitive-critical	Found in Applegate River and Williams Creek within orchard boundary but outside production areas.
Western pond turtle (*Clemmys marmorata*)	Species of concern (FWS) (Northwestern sub-species only)	Sensitive-critical	Found occasionally in orchard ponds, and Applegate River and Williams Creek sloughs.
Common kingsnake (*Lampropeltis zonata*)	Species of concern (FWS)	Sensitive-vulnerable	Found occasionally in the orchard.
Pacific lamprey (*Lampetra tridentata*)	Species of concern (FWS)	Sensitive-vulnerable	Seasonally found in the Applegate River and Williams Creek within orchard boundary but outside production areas.
Chinook salmon (*Oncorhyncus tshawytscha*)	--	Sensitive-critical (South Coast fall run stocks)	Seasonally found in Applegate River and Williams Creek within orchard boundary but outside production areas.
Steelhead (*Oncorhyncus mykiss*)	--	Sensitive-vulnerable	Seasonally found in Applegate River and Williams Creek within orchard boundary but outside production areas.
Northern goshawk (*Accipiter gentilis*)	Species of concern (FWS) Sensitive (BLM)	Sensitive-critical	Never documented at the orchard. A vagrant (dispersing) bird could pass through the orchard.
Great gray owl (*Strix nebulosa*)	--	Sensitive-vulnerable	Never documented at the orchard. A vagrant (dispersing) bird could pass through the orchard lands.

Riparian Areas

Riparian habitat at Provolt consists largely of three types: irrigation ditches, forested woodlands, and gravel bars and terraces along Williams Creek and the Applegate River. The irrigation ditches are dominated largely by blackberry species, cattails, rushes, sedges, teasel, and reed canary grass. Forested woodlands are common along Williams Creek and the Applegate River. The riparian forests are dominated by black cottonwood with subdominants including big-leaf maple, red alder, and Oregon ash. The forest understory is dominated by the exotic, invasive Himalayan blackberry. Other species in the forest understory include willow, climbing nightshade, wild grape, poison hemlock, and California smilax (*Smilax californica*). The California smilax is a Bureau Tracking species. Approximately 40 scattered individuals of this plant have been identified along Williams Creek and the Applegate River, north of Highway 238. The Himalayan blackberry is a major threat to its existence; however, larger individuals of smilax are able to climb above the blackberry to escape some competition.

The gravel bars and stream terraces along the rivers support native and weedy species, many of which are restricted to moist habitats. Willows, mullein, teasel, willow-herb, rough cat's ear, yellow monkey flower, American brooklime, creeping buttercup, and reed canary grass are some of the species found on the gravel bars.

Noxious Weeds

Several noxious weed species have been documented at Provolt, including Himalayan blackberry, bull thistle, Dyers woad, puncturevine, yellow star thistle, Canada thistle, spiny cocklebur, and poison hemlock. Other weedy species include Klamath weed (St. Johnswort), jimson weed, fiddleneck, chicory, dock, plantain, dandelion, mullein, rough cat's ear, storksbill, and Queen Anne's lace.

Special Status Plants

There are no occurrences of the Federally listed plants Gentner's fritillary (*Fritillaria gentneri*), Cook's lomatium (*Lomatium cookii*), or dwarf wooly meadow-foam (*Limnanthes floccosa* ssp. *pumila*).

3.7.1.2 Terrestrial Species

The wildlife on the Provolt Seed Orchard grounds consists mainly of animal species that are adapted to early successional vegetation environments and are highly tolerant of disturbance. The small number of wildlife species has been well documented over the years through monitoring studies or observation. Most species reside in adjacent habitats and utilize the orchard grounds infrequently.

The majority of the seed orchard is covered either by conifer species planted for seed production or open grassy areas. The conifers are evenly spaced with very little shrubs or woody debris. The undergrowth is highly managed using tilling or mowing and provides little cover for wildlife. No older seral habitat exists on the orchard lands. The grasslands around the plantations are also highly managed by tilling or mowing and are composed of thick stands of both native and exotic grass species. Two small ponds are present on the orchard lands, one next to the offices and the second near the southern boundary of the site. The runoff drainage flows in straight ditches and irrigation canals and, unlike typical riparian stream areas, there is little bankside vegetation to provide habitat for wildlife. Few large trees or snags exist within the fenceline of the seed orchard. A river and wooded riparian vegetation is located outside of the orchard lands, which may provide habitat for species who may occasionally visit the site.

Provolt is enclosed by a perimeter fence. This perimeter partially or completely excludes many wildlife species that occur in the surrounding habitats. Even though they are common in the surrounding areas, large mammals such as deer, elk, and sometimes black bears and mountain lions are excluded by the fence. However, bats and songbirds are encouraged to use the orchard lands, with nesting or roosting boxes installed in 1995 through 2000. These flying species help control the insect population. Bats also use the structures in the orchard as roosting areas.

Smaller mammals have been documented on or in the vicinity of the site. Beaver and otter inhabit sloughs along the river. Marten and fisher occur two miles from the orchard but, because they prefer forested habitat, they do not use the orchard lands. Porcupine are occasionally found on the orchard lands, but are considered a pest species. Other small mammals include bobcat, grey fox, coyote, long-tailed weasel, silver grey squirrel, jackrabbit, the California ground squirrel, voles, mice, and gophers.

Reptiles occasionally are seen at Provolt. The common kingsnake has been encountered several times in the tall grass adjacent to the riparian areas. Western pond turtles are found in the onsite pond and river sloughs. The sharp-tailed snake could also occur on the grounds, although has not been documented. Other reptiles and amphibians include the gopher snake, western fence lizard, alligator lizard, and frogs.

Upland game birds sometimes fly over the fence to forage and roost in the orchard. These species include wild turkey, pheasant, valley quail, blue grouse, and ruffed grouse. Because the grass is mowed several times a year, these species do not have much cover in the tree plantations. The sloughs and ponds are frequented by ring-necked ducks, widgeons, and wood ducks. There is also a great blue heron rookery in the northeast corner of the site. It is mostly located on the adjacent private property.

Ospreys nest in the vicinity as well as on orchard lands. They rarely have an impact on prey species on site because they feed almost exclusively on fish. Occasionally they use river sloughs and ponds on-site to capture warm water fish. Other raptors nest outside the orchard boundary, but may use the orchard for foraging. These species could include the great gray owl, northern goshawk, great horned owl, and common barn owl.

Special Status Terrestrial Wildlife Species

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is a Federally and state-listed threatened species that may hunt at Provolt. This bird is well-recognized as a national symbol in the U.S., with a powerful dark-brown body and white head and tail. It usually frequents aquatic ecosystems, subsisting largely on fish, but also consumes birds and carrion. The bald eagle requires large trees or cliffs for nesting. In western Oregon, nests are constructed in large dominant trees that are above surrounding trees, and are usually in the line of sight of a major water body.

The bald eagle was first listed under the ESA as endangered in 1978. It was downlisted to threatened in 1995. In 1999, a proposed rule was published to de-list the species completely, based on a finding that the species has recovered as a result of protections initiated under the ESA and a reduction of persistent organochlorine chemicals such as DDT in the environment. No final action has been taken by FWS on the 1999 proposal.

Bald eagles forage along the Applegate River during the nesting season and in the winter. A new nest was discovered in 2000 at Pennington Mountain, two miles west of the orchard. The next nearest known nest is 15 miles downstream at Sloan Mountain, with another at 19 miles south-southeast at Applegate Reservoir. A pair of eagles has been consistently observed four miles downstream of the orchard near the Copeland

Gravel Quarry, but no nest has been identified. Eagles could be expected to occasionally hunt the ponds at Provolt for fish and ducks. Due to the small acreage in ponds, and the limited cover in the managed orchard, eagle use of the seed orchard grounds is likely to be very sporadic.

Northern Spotted Owl

The northern spotted owl (*Strix occidentalis caurina*) is a Federally and state-listed threatened species that may occur near Provolt. It is a medium-sized owl with dark eyes and dark-to-chestnut brown coloring, with whitish spots on the head and neck and white mottling on the abdomen and breast. They require old-growth forest habitats for nesting and foraging. Favored prey is the northern flying squirrel and the woodrat. These birds nest in trees large enough to provide a cavity or platform that can hold a nest and young. In the Coast Range, Douglas-fir reach this size at about 80 years old. Also at this age, forested stands begin to develop snags and coarse woody debris that provide suitable habitat for the owls' prey species.

The northern spotted owl was Federally listed as threatened throughout its entire range (California, Oregon, Washington, British Columbia) in 1990, due to extensive loss of habitat in old-growth and late-successional forests. The State of Oregon had listed the species threatened since the late 1970s.

The nearest historic spotted owl site (Pennington Ridge) is located 3½ miles west of the seed orchard, where an adult pair was present in 1996, but the last successful nesting was in 1992. "Floater" single owls or dispersing juveniles could be expected to pass through the orchard vicinity occasionally. The nearest suitable habitat is 3/4 mile to the southwest. Dispersing owls could be expected to roost in hardwood and riparian woodlots within the orchard boundary. Northern spotted owls are thought to only rarely forage in open clearcut type habitat, such as those at Provolt. Negligible numbers of the owl's favored prey species would be expected to be found within the orchard. Spotted owls avoid such open habitat because they are vulnerable to predation by the great horned owl, goshawk, and red-tailed hawk.

Other Special Status Species

The northern goshawk (*Accipiter gentilis*) is a FWS species of concern, BLM sensitive species, and state-listed sensitive species that could pass through Provolt. The mature, old-growth forest habitat required for nesting is not found at or within a half mile of Provolt.

The western pond turtle (*Clemmys marmorata*) is listed as a sensitive species by ODFW, and is known to occur at Provolt. The subspecies northwestern pond turtle (*Clemmys marmorata marmorata*) is also a Federal species of concern. The western pond turtle's distribution and abundance have declined as a result of commercial exploitation for the pet trade, habitat loss and degradation, introduced species, and disease (NatureServe 2001).

The common kingsnake (*Lampropeltis zonata*) is known to occur at Provolt. It is a FWS species of concern, and is also listed as a sensitive species by the state of Oregon. The common kingsnake is primarily terrestrial, feeding on reptiles and their eggs, birds and their eggs, amphibians, and small mammals.

The great gray owl (*Strix nebulosa*), a state of Oregon sensitive species, could nest on adjacent private or public lands and occasionally forage in the open orchard habitat. However, orchard personnel have not detected these owls, and there have been no surveys nearby.

3.7.1.3 Aquatic Species

The fisheries within the orchard and vicinity are separated into two categories: coldwater anadromous and coldwater resident. The Applegate River forms the northern boundary of the Provolt Seed Orchard, and is inhabited by the anadromous fish species chinook salmon, coho salmon, summer and winter steelhead, and Pacific lamprey. Native coldwater resident species found throughout the Applegate Watershed include cutthroat trout, rainbow trout, speckled dace, reticulate sculpin, brook lamprey, and the Klamath smallscale sucker. Redside shiners and squaw fish are some exotic resident species present in the river. Many of the coldwater anadromous species, as well as the cutthroat trout, are considered special status species and are discussed separately below.

Williams Creek enters the Applegate River just outside the boundaries of the Provolt Seed Orchard. It is inhabited by the same native and exotic fish species that are present in the Applegate River.

Water quantity and quality are limiting factors for trout and salmon production in Williams Creek and in the Applegate River. Within portions of the Provolt Seed Orchard, as is typical of the riparian reserves on private agricultural land, the overstory vegetation has been virtually eliminated, with just a few trees shading the stream. This contributes to the warming of stream temperatures in the summer months.

High water temperatures are also the primary factor in the reduced benthic biodiversity in Williams Creek. ODEQ has established a seven-day average daily maximum water temperature standard of 64 °F (OAR 340-041-0006). During the summers of 1996-98, the seven-day average daily maximum water temperatures exceeded the standard by an average of 9.5 °F. During the summer, coho salmon, steelhead, and cutthroat trout use tributaries to Williams Creek as refuge from the excessive stream temperatures and reduced flow.

Some warm-water species are found within the two ponds located on Provolt Seed Orchard lands, although these do not constitute a major fishery in the area. One pond is adjacent to the seed orchard office and Highway 238. Largemouth bass were documented in the pond, and it is assumed that other species of warm water fish, typical of most Rogue Basin farm ponds, reside there as well. These may include bluegill, green sunfish, black crappie, brown bullhead, and yellow perch. The second pond is adjacent to Williams Highway. No fish were documented during a spring 1999 survey, but it is expected that similar warm water species are present. This pond has dried up three of the past five years (1998 to 2002) due to winter drought conditions, so fish have died and repopulation is slow and sporadic.

The Pacific salmon habitat found in the Applegate River has been identified as freshwater EFH for both the chinook and coho salmon (Pacific Fishery Management Council 1999). NOAA Fisheries is charged to designate and protect EFH in accordance with the provisions of the *Magnuson-Stevens Fishery Conservation and Management Act*, as amended by the *Sustainable Fisheries Act* of 1996.

Special Status Aquatic Species

Coho Salmon

Naturally spawned southern Oregon/northern California coasts populations of coho salmon (*Oncorhynchus kisutch*) are a Federally listed threatened species and state-listed sensitive species. Members of this evolutionarily significant unit of coho salmon spawn in coastal streams from Cape Blanco, Oregon to Punta Gorda, California.

Coho salmon are anadromous fish, meaning they migrate from the ocean to spawn in fresh water. After the adults reproduce, they die. Coho salmon eggs incubate in gravel nests in freshwater rivers, then hatch as the larval stage called alevins, which depend on food stored in a yolk sac. After the yolk sac is absorbed, juvenile coho emerge from the gravel nest as fry during late winter/early spring. They rear in slow fresh water habitats for one year, after which they migrate to the ocean as smolts. Coho salmon smolts typically migrate to sea in the spring, spend 16 to 20 months rearing in the ocean, then return to freshwater as adults in the fall and spawn from October to January. (After the first summer at sea, a small proportion of the males reach early sexual maturity and return that fall as two-year-old "jacks.") The typical life cycle for Oregon coho salmon is to spend one year in freshwater and eighteen months in saltwater. Variation from this pattern does occur with some juvenile coho spending a second summer and precocious males returning to spawn a year early as jacks.

Southern Oregon/northern California coasts coho salmon were listed as threatened under the ESA on May 6, 1997 (62 FR 24588), due to habitat degradation, harvest, and artificial propagation exacerbating the adverse effects of natural environmental variability brought about by drought, floods, and poor ocean conditions. NOAA Fisheries designated all river reaches accessible to listed coho salmon between Cape Blanco and Punta Gorda as critical habitat (64 FR 24049).

Williams Creek was identified as a high value "core area" watershed for coho salmon production in the Southwest Oregon Salmon Restoration Initiative (RVCOG 1997). Coho salmon were recently observed entering Laurel Hill Ditch.

Cutthroat Trout

Coastal cutthroat trout (*Oncorhyncus clarki clarki*) is a FWS species of concern, and also a state-listed vulnerable species. This subspecies of cutthroat trout spawns mainly in late winter or early spring; some survive to spawn more than once (NatureServe 2001). They are vulnerable to anthropogenic degradation of headwater streams and spawning areas (NatureServe 2001). Coastal cutthroat trout are found throughout the Applegate watershed.

Pacific Lamprey

Pacific lamprey (*Lampetra tridentata*) are present in the Applegate River and Williams Creek. This fish is a FWS species of concern and is also a state-listed sensitive species. Its numbers have declined in some areas due to dams and habitat degradation (NatureServe 2001).

Chinook Salmon

South Coast fall run stocks of chinook salmon (*Oncorhyncus tshawytscha*) are a state-listed sensitive species. Chinook salmon was a Federal candidate species found to not warrant listing under the ESA. This anadromous fish is present in the Applegate River.

Steelhead

Coastal steelhead (*Oncorhyncus mykiss*) is a state-listed sensitive species found in the Applegate River. It was a Federal candidate species found to not warrant listing under the ESA. Certain distinctive groups, termed evolutionarily significant units (ESUs), of *Oncorhyncus mykiss* are listed as threatened under the ESA; however, these ESUs are not found in Williams Creek or the Applegate River. Steelhead are the anadromous members of this species, meaning that they migrate from the ocean to spawn in fresh

water. Members of this species may also have a life cycle completely in fresh water; these fish are called rainbow or redband trout, and are cited separately on the ODFW list of sensitive species.

3.7.2 Sprague Seed Orchard

Several species present, potentially present at Sprague, or in streams and rivers outside the boundaries and downstream from Sprague have a special status under Federal or state laws or recommendations. These species include four birds, one reptile, five fish, and two plants, as listed in Table 3.7-2.

Special status species are described within the appropriate sub-section below.

3.7.2.1 Vegetation

Orchard Areas

Sprague Seed Orchard is a plantation for the production of sugar pine and ponderosa pine seeds. Sugar pine is the primary tree in production at the orchard. The understory areas in the orchards are dominated by perennial pasture grasses (cover crop) such as orchard grass, timothy, tall fescue, wild oats, vetch, ryegrass, barley, hedgehog dogtail, and bulbous bluegrass. At some locations, some scattered native trees can be found. These include ponderosa pine, incense cedar, Oregon white oak, California black oak, Pacific madrone, and Douglas-fir.

Riparian Areas

Riparian buffers at Sprague are composed predominantly of native vegetation. Upland forest species found on the dryer edges include Douglas-fir, ponderosa pine, incense cedar, madrone, Oregon white oak, California black oak, manzanita, buckbrush, and poison oak. At wetter locations, species include willows, black cottonwood, Oregon ash, big-leaf maple, wild mock orange, tall snowberry, camas, Howell's false-caraway, sedges, and various rushes. Stream channels are dominated by cluster rose and Douglas's spiraea. Where disturbance has occurred, the exotic plant Himalayan blackberry is common.

Howell's false-caraway (*Perideridia howellii*) is a BLM Tracking species. This large herbaceous species is common along the stream channels at the orchard and has been found in nearly all the riparian areas at the site. Seedlings are found on recent, wet stream deposits.

Noxious Weeds

Several noxious weed species are known to occur at Sprague. These include bull thistle, Himalayan blackberry, poison oak, yellow star thistle, Scotch broom, chicory, and Canada thistle. Other weed species that occur in the orchard units, fields, and along roadsides include Klamath weed (St. Johnswort), dock, plantain, dandelion, mullein, nutsedge, rough cat's ear, storksbill, and Queen Anne's lace.

Special Status Plants

Two special status plant species are known to occur at Sprague in riparian stream buffers, dry drainage ditches, and other low, seasonably wet spots. Slender meadow-foam (*Limnanthes gracilis* var. *gracilis*) and coral-seeded allocarya (*Plagiobothrys figuratus* var. *corallicarpa*) are BLM sensitive species. There are no occurrences of the Federally listed plants Gentner's fritillary (*Fritillaria gentneri*), Cook's lomatium (*Lomatium cookii*), or dwarf wooly meadow foam (*Limnanthes floccosa* ssp. *pumila*).

Table 3.7-2. Special Status Species At or Near Sprague

Species	Federal Status	State Status	Orchard Occurrence
Northern spotted owl (*Strix occidentalis caurina*)	Threatened	Threatened	Never documented at the orchard. Dispersing single owls may pass through or overnight occasionally in orchard woodlots or riparian areas. Nearest owl nest site is four miles northwest of the orchard.
Coho salmon (*Oncorhynchus kisutch*)	Threatened	Sensitive-critical	Not found in the orchard. Found in lower Jump-off Joe Creek one mile or more from the orchard boundary.
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Threatened	Never documented at the orchard. A vagrant wandering bird could pass through the orchard. Nearest known nest site is six miles southwest of the orchard near the Rogue River.
Northern goshawk (*Accipiter gentilis*)	Species of concern (FWS) Sensitive (BLM)	Sensitive-critical	Never documented at the orchard. A vagrant (dispersing) bird could pass through the orchard.
Western pond turtle (*Clemmys marmorata*)	Species of concern (FWS) (Northwestern sub-species only)	Sensitive-critical	Found occasionally in or near the lake
Cutthroat trout (*Oncorhyncus clarki clarki*)	Species of concern (FWS)	Sensitive-vulnerable	Not found in the orchard. Found in lower Jump-off Joe Creek one mile or more from the orchard boundary.
Pacific lamprey (*Lampetra tridentata*)	Species of concern (FWS)	Sensitive-vulnerable	Not found in the orchard. Found in lower Jump-off Joe Creek one mile or more from the orchard boundary.
Coral-seeded allocarya (*Plagiobothrys figuratus* var. *corallicarpa*)	Species of concern (FWS) Sensitive (BLM)	--	Found in intermittent drainage channels and seasonally wet areas, also adjacent surrounding properties. Two small widely separated populations are in the orchard, outside of production areas.
Slender meadow-foam (*Limnanthes gracilis* var. *gracilis*)	Species of concern (FWS) Sensitive (BLM)	--	Found in intermittent drainage channels, seasonally wet open areas, and adjacent surrounding properties. Several populations in the orchard.
Great gray owl (*Strix nebulosa*)	--	Sensitive-vulnerable	Never documented at the orchard. A vagrant (dispersing) owl may pass through the orchard lands.
Chinook salmon (*Oncorhyncus tshawytscha*)	--	Sensitive-critical (South Coast fall run stocks)	Not found in the orchard. Found in lower Jump-off Joe Creek one mile or more from the orchard boundary.
Steelhead (*Oncorhyncus mykiss*)	--	Sensitive-vulnerable	Not found in the orchard. Found in lower Jump-off Joe Creek one mile or more from the orchard boundary.

Slender meadow-foam and coral-seeded allocarya are found along intermittent drainage channels and other low, seasonally wet areas. Both species are small annual herbs that are endemic to southwestern Oregon. The locations where these species occur have saturated soils during the winter months, but are dry during the summer. Approximately 1,000 plants of the meadow-foam are known to occur at Sprague, covering about 100 square meters. There are two widely separated, small populations of coral-seeded allocarya with a combined total of approximately 60 plants, covering about 100 square meters. Populations of both species extend beyond the orchard boundaries onto surrounding properties where they occur in intact Oregon white oak woodland. The off-site population areas may provide a seed source that supplements that part of the populations that occur at the seed orchard.

3.7.2.2 Terrestrial Species

The species that occur at Sprague are adapted to early-successional vegetation environments and are highly tolerant of disturbance. Monitoring studies and onsite observation have documented the small number of wildlife species present. Most species reside in adjacent habitats and utilize the orchard grounds infrequently.

The seed production and open grassy areas provide little cover for wildlife. No older seral habitat exists on the orchard grounds. The grasslands are managed by tilling or mowing and are composed of thick stands of both native and exotic grass species. One pond is located on the orchard lands.

The orchard is enclosed by a perimeter fence that partially or completely excludes many wildlife species that occur in the surrounding habitats. Deer use open gates or gaps in the fenceline to enter onto the orchard lands. Coyotes are occasionally seen on-site. Other large mammals such as elk, and sometimes black bears, and mountain lions are excluded by the fence. Other species have been encouraged to use the orchard grounds with nesting box installations. These bird species help control the insect population and include tree swallows, western bluebirds, house wrens, and flycatchers.

Porcupine, silver grey squirrel, jackrabbit, the California ground squirrel, voles, mice, and gophers all use the grasslands and orchard units.

Reptiles and amphibians occasionally occur at Sprague. Western pond turtles utilize the pond on orchard lands. The sharp-tailed snake could also occur on the lands, although it has not been documented. Other species include the western fence lizard, gopher snake, and frogs.

Upland game birds sometimes fly over the fence to forage and roost in the orchard, including wild turkey, pheasant, valley quail, blue grouse, and ruffed grouse. Because the grass is mowed several times a year, these species do not have much cover in the orchard units.

Raptors, such as the great gray owl, nest outside the orchard boundary, but may use the orchard for foraging.

Special Status Terrestrial Wildlife Species

Bald Eagle

The bald eagle (described in detail in Section 3.7.1.2) is a Federally listed threatened species. Although it has never been documented at Sprague, a vagrant wandering bird could pass through the orchard. The nearest known nest site is six miles southwest of the orchard near the Rogue River.

Northern Spotted Owl

The northern spotted owl (described in detail in Section 3.7.1.2) is a Federally listed threatened species that may occasionally visit Sprague. Vagrant (dispersing) northern spotted owls may also occasionally use the site for roosting during dispersal.

Other Special Status Species

The northern goshawk (*Accipiter gentilis*) is a FWS species of concern, BLM sensitive species, and state-listed sensitive species that could pass through Sprague. The mature, old-growth forest habitat required for nesting is not found at Sprague or within ½ mile.

The western pond turtle is described briefly in Section 3.7.1.2; it is known to occur in and near the pond at Sprague.

The great gray owl (*Strix nebulosa*) is a State of Oregon sensitive species which could nest on adjacent private or public lands and occasionally forage in the open orchard habitat. However, orchard personnel have not detected owls, and there have been no surveys nearby. As the area surrounding Sprague becomes more urbanized (land cleared, homes built, woodlot habitat altered), the probability of nearby nesting of goshawk and great gray owl will decline substantially.

3.7.2.3 Aquatic Species

Fish inhabit lower Jump-off Joe Creek, south, downstream, and about one mile from the orchard, and are separated into two categories, coldwater anadromous and resident. The following coldwater anadromous fish use lower Jump-off Joe Creek for migration, rearing, and spawning: chinook salmon, coho salmon, steelhead, and Pacific lamprey. In addition, the native coldwater resident species cutthroat trout, sculpin, speckled dace, and Klamath smallscale sucker are present in Jump-off Joe Creek about one mile from the orchard. Exotic fish, including the Umpqua pike minnow and the redside shiner, thrive in the elevated stream temperatures. Many of the coldwater anadromous species as well as the cutthroat trout are considered special status species as discussed in Section 3.7.1.3.

The unnamed intermittent drainage that helps forms Lake CASSO enters Jump-off Joe Creek in Section 16. The exotic green sunfish was found throughout the stream. Green sunfish most likely entered the stream from Lake CASSO's spillway. Several amphibians were also observed, including the native Pacific chorus frog and the exotic bullfrog. In addition, an unidentified crayfish species was observed. Filamentous green algae were ubiquitous during one spring survey, indicating poor water quality and excessive water temperatures incapable of supporting salmonid fishes.

Summer water temperatures in Jump-off Joe Creek can be high and are a primary factor in the reduced benthic biodiversity found in the creek. During the summers of 1996-98, the seven-day average daily maximum water temperatures in Jump-off Joe Creek exceeded ODEQ's water temperature standard of 64 °F by an average of 12 °F.

Lake CASSO is located within the boundaries of the Sprague Seed Orchard. The artificially created pond is adjacent to the railroad tracks in Section 9. The water level is regulated by the concrete spillway at the southernmost end of the pond. No fish were captured during a March 1999 survey; however, it is assumed that warm-water fish species, typical of most Rogue Basin farm ponds, are present. These may include bluegill, green sunfish, black crappie, brown bullhead, and yellow perch.

Chinook salmon and coho salmon use the lower portion of Jump-off Joe Creek for migration, rearing, and spawning. However, Jump-off Joe Creek was not listed as freshwater EFH for Pacific salmon (Pacific Fishery Management Council 1999). The

Magnuson-Stevens Fishery Conservation and Management Act, as amended by the *Sustainable Fisheries Act* of 1996, charges NOAA Fisheries to designate and protect EFH.

Special Status Aquatic Species

Coho Salmon

As described for the Provolt Seed Orchard, naturally spawned southern Oregon/ northern California coasts populations of coho salmon are a Federally listed threatened species and state-listed sensitive species. See detailed discussion in Section 3.7.1.3. Coho salmon use the lower 12 miles of Jump-off Joe Creek for migration, rearing, and spawning.

Other Special Status Species

Coastal cutthroat trout and Pacific lamprey are described briefly in Section 3.7.1.3. They are both found throughout the entire Jump-off Joe Creek watershed.

South Coast fall run stocks of chinook salmon (*Oncorhyncus tshawytscha*) are a state-listed critical species of anadromous fish that are present in the lower four miles of Jump-off Joe Creek. This was a Federal candidate species found to not warrant listing under the ESA.

Steelhead (described in Section 3.7.1.3) is a state-listed vulnerable species found in lower Jump-off Joe Creek.

3.8 Noise

Noise is defined as any unwanted sound that interferes with normal activities or in some way reduces the quality of the environment. Ambient noise levels vary greatly in magnitude and character from one location to another, depending on the normal activities conducted in the area. In general, noise levels around Provolt result primarily from traffic and agricultural operations. Noise around Sprague is generated from traffic, timber, and aircraft operations.

3.8.1 Noise Descriptors

Community response to noise is not based on a single event, but on a series of events over the day. Factors that have been found to affect the subjective assessment of the daily noise environment include the noise levels of individual events, the number of events per day, and the time of day at which the events occur. Most environmental descriptors of noise are based on these three factors, although they may differ considerably in the manner in which the factors are taken into account. Two types of noise measures are used to describe impacts on an existing environment. These include the decibel and the equivalent sound level. These measures and their application to noise environments are discussed below.

A decibel (dB) is the physical unit commonly used to describe sound levels. Sound measurement is further refined by using an "A-weighted" decibel (dBA) scale that emphasizes the audio frequency response curve audible to the human ear. Thus, the dBA measurement more closely describes how a person perceives sound. For example, typical noise levels include a quiet urban nighttime (40 dBA), an air conditioner operating 100 feet away (55 dBA), and a heavy truck moving 50 feet away (85 dBA). Table 3.8-1 shows noise levels for various human activities.

Typical noise at the orchard generated by trucks, tractors, mowers, and other power equipment is described over an eight-hour time period, using the equivalent sound level

Table 3.8-1. Typical Decibel Levels Encountered in the Environment

Sound Level (dBA)	Source of Noise	Subjective Impression
10	--	threshold of hearing
20	rustling leaves	
30	quiet bedroom	
35	soft whisper at 5 ft; typical library	
40	quiet urban setting (nighttime); normal level in home	threshold of quiet
50	light traffic at 100 ft; quiet urban setting (daytime)	
55	--	desirable limit for outdoor residential area use
65	automobile at 100 ft	acceptable level for residential land use
70	pickup truck at 50 ft; Freight train at 100 ft	threshold of moderately loud
80	tractor at 50 ft; power saw at 50 ft	most residents annoyed
85	heavy truck at 50 ft; helicopter flyover at 30 ft altitude at 600 ft distance	threshold of hearing damage for prolonged exposure
95	freight train at 50 ft; large lawn mower	
100	heavy diesel equipment at 25 ft; chainsaw	threshold of very loud
120	jet plane taking off at 200 ft	threshold of pain
135	civil defense siren at 100 ft	threshold of extremely loud

Sources: 14 CFR 36.805, Cavanaugh 1998, Suter 1991, U.S. Army 1976, EPA 1974

(L_{eq}). L_{eq} is calculated using the dBA levels of noise events averaged over time, taking into account the usage factor (the proportion of time that a maximum level of noise is generated) of various types of equipment. Table 3.8-2 provides approximate sound levels for a typical mix of orchard equipment, estimated with L_{eq}.

Noise generated near the ground generally attenuates 6 dB for each doubling of distance from a noise source; trees and terrain can further increase attenuation. Noise generated above ground level (above 50 ft) generally attenuates about 2 dB for every doubling of distance. Attenuation of outdoor noise sources is complex, influenced by atmospheric conditions (wind speed and direction, relative humidity, and cloud cover), topography (flat terrain versus hills and mountains), tree cover, and other barriers such as buildings.

3.8.2 Existing Noise Environments at Provolt and Sprague

Provolt is located in the valley of the Applegate River near the town of Provolt. Typical ambient noise levels for the mix of land use would average around 50 dBA. About eight residences are within ¼ mile of the orchard. There are no buffers of trees between the orchard and these residences. Provolt Community Church is located about 150 feet southwest of a multiple use area of the seed orchard and about 320 feet southwest of the nearest orchard production unit.

Sprague is located in an area of forested land and acreages in rolling hills and low mountains near the Rogue River. Typical ambient noise levels for the mix of land use

would average around 50 dBA. About 23 residences are within ¼ mile of the orchard. There are buffers of trees between the orchard and these residences.

Noise at both seed orchards is generated by trucks, tractors, greenhouse fans, security alarms, and power equipment used for daily operations. Typically, a mix of equipment would intermittently generate around 75 dBA at a distance of 50 feet, averaged over an eight-hour period. Not including the effects of terrain and trees, these estimated noise levels would be expected to attenuate to 69 dBA at 100 feet and to 45 dBA at 1,600 feet (see Table 3.8-2).

One landing strip is located in the vicinity of Provolt, about nine miles to the east. The Josephine County Airport is located about two miles to the southeast of Sprague. Various aircraft contribute intermittent noise to the noise environment in the vicinities of both seed orchards.

3.9 Cultural Resources

3.9.1 Provolt Seed Orchard

This portion of the Applegate Valley where the Provolt Seed Orchard is located was used by native peoples, with sites and villages along the river. Consistent with other native peoples of the region, they were hunters and gatherers. The Applegate River valley provided an abundance of resources: fish, nuts, seeds, roots, and game. These resources were managed and enhanced by native activities, especially regular burning, which contributed to the character of the local vegetation.

This area was visited by Peter Skene Ogden, a trapper working for the Hudson Bay Company, in 1828. Following Ogden, various trappers and explorers worked and traveled through the area. The discovery of gold in the early 1850s brought miners into the Applegate Valley, creating conflicts with the native peoples. Fighting ensued and lasted intermittently until 1856 when the surviving native peoples were taken to reservations in northern Oregon. Settlement of the area increased, with agriculture and

Table 3.8-2. Approximate Sound Levels (dBA) of Orchard Equipment

Equipment	Averaging Time	Sound Levels (dBA) at Various Distances (ft)[a]					
		50	100	200	400	800	1,600
Chain saw	8 hours	101	95	89	83	77	71
Mower	8 hours	90	84	78	72	66	60
Tractor	8 hours	79	73	67	61	55	49
Power saw	8 hours	73	67	61	55	49	43
Pickup truck	8 hours	66	60	54	48	42	36
Composite	8 hours	75	69	63	57	51	45
Composite	24 hours	78	72	66	60	54	48

[a]Noise attenuation of 6 dBA for each doubling of distance assumes flat terrain with no trees or buildings. Trees and buildings would increase the attenuation, reducing noise levels at various distances. Assumes a background noise level of 45 dBA for a typical rural (farm) area (Cavanaugh 1998)
Sources: U.S. Army 1976, Cavanaugh 1998, Cunniff 1977.

mining being the dominant pursuits in the nineteenth century. The seed orchard was established in the early 1980s.

A cultural resource survey of Provolt did not locate any historic or archaeological materials in the seed orchard (BLM 2000). Visibility was very poor due to heavy grasses. The seed orchard is located on a low-lying terrace with soils composed of water laid sands and gravels, suggesting that the terrace has been frequently flooded in the past; the potential for finding cultural materials in such situations is low. Active flood plains are not good locations for habitation, and remains from any short-term camps or activities are likely to have been washed away.

3.9.2 Sprague Seed Orchard

Sprague borders the small valley along Jump-off Joe Creek. The native peoples who inhabited this land, prior to Euro-American contact, lived along Jump-off Joe Creek near Merlin and also along the Rogue River at its confluence with the creek. Archaeological sites including native villages are known along the Rogue River, and are reported along Jump-off Joe Creek, although the preponderance of private land along the creek has precluded a systematic archaeological survey of the area.

The native peoples in this area were hunter-gatherers, and the native landscape within the seed orchard would have provided multiple resources for the local inhabitants: acorns, sugar pine nuts, grass seeds, water, and game. Native peoples regularly used fire to maintain some of the landscapes within which they lived to enhance the resources upon which they depended. Given the proximity of known sites and villages, it is highly likely that the native landscape of the seed orchard was both used and maintained by local peoples for many centuries.

During the initial period of contact with non-native peoples (1828 to 1850), early travelers and explorers came through the area, sometimes following Jump-off Joe Creek and passing near, if not through, the location of the seed orchard. The discovery of gold in the early 1850s brought thousands of miners to the region as well as an intense period of conflict with the native peoples, known as the Rogue Indian Wars. Fighting took place throughout the region, including along Jump-off Joe Creek. By 1856, the native peoples were defeated and taken to reservations in the northern part of the state, and Euro-American settlement expanded throughout the area.

In the 1880s, the Southern Pacific railroad was completed between Oregon and California, opening southern Oregon to travel and trade, and promoting the development of various industries including agriculture, ranching, and logging. The town of Merlin was established as a railroad stop in the early 1880s, and logging of low elevation lands may have become significant at this time. The railroad runs through the seed orchard, and access to the rail line by local timber cutters would have been easy.

A cultural resource survey of the seed orchard identified several isolated artifacts relating to use of the orchard lands by native peoples, but there are no archaeological or historic sites (BLM 2000).

3.10 Socioeconomics and Environmental Justice

Socioeconomic resources are described in this section using employment, income, and demographic measures. Economic and demographic elements are key factors influencing changes in demand for goods and services within a local economy. Because there are no personnel changes associated with the proposed action or alternatives, the local housing market, schools, community services, and infrastructure will not be discussed in this document.

Provolt is located southwest of the city of Grants Pass, Oregon, near the small community of Applegate. The seed orchard lies mostly within Josephine County, with the remainder in Jackson County. Jackson County comprises the one-county Medford Metropolitan Statistical Area.[5]

Sprague is located northwest of the city of Grants Pass, Oregon, near the small community of Merlin. The seed orchard lies entirely within Josephine County.

Josephine County is defined as the region of influence (ROI) for the analysis of socioeconomic and environmental justice impacts for both orchards.

3.10.1 Community and Population

Josephine County is a predominantly rural county. Approximately 30% of the county's population of 75,907 resides in Grants Pass, 15% in small municipalities, and the remaining 55% in unincorporated areas (OED 2002). The areas immediately adjacent to both seed orchards are generally rural in character, as discussed in Section 3.5.

Josephine County is the twelfth-most populous county in Oregon, representing over 2% of Oregon's population of 3,429,399. The county's population increased by 21% during the 1990s. During the 1980s, however, regional economic downturns early in the decade led to a population increase of only 7% (USBC 2002a, USBC 2002c, OED 2002).

The state population grew by 21% between 1990 and 2000, but had increased by only 8% during the 1980s. The population of Grants Pass in 2000 was 23,000 (the populations of Applegate and Merlin are not available) (USBC 2002a).

3.10.2 Economic and Income Characteristics

Josephine County had a labor force of 34,583 in 2000, a 28% increase over 1990 employment, which in turn had increased by 21% between 1980 and 1990. The county's employment represents less than 2% of the state's total. As of 2000, Josephine County had a fairly diversified economy, as employment has gradually shifted from its heavy dependence on agriculture and wood products to services, retirement, and tourism (OED 2002). Nearly one-third of the county's employment is in the services sector, about 22% in wholesale and retail trade, and 12% in manufacturing. The financial, insurance, and real estate sector and construction were the other major non-governmental employment sectors, accounting for 7% and 6% of jobs, respectively, while the farm employment sector and the agricultural services, forestry, and fishing sector combined provided nearly 6% of county jobs. Government provided 13% of all county jobs, with local government accounting for about three-fourths of the government jobs. Federal civilian employment constitutes nearly 8% of government jobs and 1% of all jobs in Josephine County. Farm employment provides 3% of employment, about 1½ times the proportion of the sector's employment for the U.S. The agricultural services, forestry, and fisheries sector also provides 3% of county employment, more than double the proportion of the U.S. sector's employment (BEA 2002).

In July 2002, unemployment in Josephine County was 8.3%, compared to 7% for Oregon and 6% for the U.S. as a whole. The average 2001 unemployment rate was 8.5% for Josephine County, 6.3% for Oregon, and 4.8% for the U.S. (OED 2002, OLMIS 2002).

Total personal income (TPI) for 2000 in Josephine County was $1.6 billion. Per capita income (PCI), which is calculated by dividing an area's TPI by its total population, is

[5]A metropolitan statistical area is a region having a high degree of economic interdependence, with geographically integrated labor, retail, and housing markets. Such regions generally consist of a central city or several cities and the surrounding communities or counties.

used to compare income across regions. The 2000 PCI in Josephine County was $21,270, which was 72% of the U.S. PCI of $29,469, and 77% of Oregon's PCI of $27,660 (BEA 2002).

Provolt has an annual budget of $300,000, approximately two-thirds of which is spent for payroll for its 3.5 full-time employees. The seed orchard spends about $58,000 annually on contracted work. The orchard's seed crop has an estimated annual value of $60,000. Cooperative agreements to provide seed and research services to other Federal agencies, local governmental units, and private timber companies are expected to yield $44,000 in fiscal year 2002. Approximately $49,500 is spent annually for various types of pest control.

Sprague has an annual budget of $325,000, approximately three-fourths of which is spent for payroll for its 2.5 full-time and 2 part-time employees. The seed orchard spends about $50,000 annually on contracted work. The orchard's seed crop has an estimated annual value of $125,000. Cooperative agreements to provide seed and research services to other Federal agencies and private timber companies are expected to yield $44,000 in fiscal year 2002. Approximately $61,000 is spent annually for various types of pest control.

3.10.3 Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was signed by the President on February 19, 1994. Environmental justice has been defined by EPA's Office of Environmental Justice as follows (EPA 1998):

> The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies.

The environmental justice EO requires that each Federal agency identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. Environmental justice also takes into consideration EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, which was signed by the President on April 21, 1997. This EO requires that each Federal agency identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on children, who are more at risk because of developing body systems, comparatively higher consumption-to-weight ratios, behaviors that may expose them to more risks and hazards than adults, and less ability than adults to protect themselves from harm.

The environmental justice ROI is Josephine County, the same as for socioeconomic resources. To evaluate these potential effects, this section describes the minority and low-income characteristics of the ROI, based on data from the 2000 Census of Population and Housing. Demographic data regarding children are presented in Table 3.6-1.

The terms "low-income" and "minority" are defined according to guidance published by CEQ in 1997 and adopted by EPA. Under this guidance, "low-income" is defined as persons below the poverty level. The poverty threshold, which is a function of family size and is adjusted over time to account for inflation, was designated by the Federal government as $17,524 for a family of one adult and three children in 2000. "Minority"

means persons designated in census data as Black (African-American), not of Hispanic origin; American Indian, Eskimo, or Aleut (Native American); Asian or Pacific Islander; or of Hispanic origin (CEQ 1997). According to the USBC definition, the Hispanic origin designation is separate from the ethnic (racial) designation, as people who identify their origin as Spanish, Hispanic, or Latino may be of any race (USBC 2001). Minority populations should be identified for environmental justice consideration where the minority population of the affected area exceeds 50% of the total population or is "meaningfully greater" than the minority population percentage in the general population of the assessment area (CEQ 1997). Tables 3.10-1 and 3.10-2 present ethnic data for census blocks containing and adjacent to Provolt and Sprague, respectively, and for Josephine County and comparison areas.

According to the 2000 census, the areas surrounding Provolt and Sprague are predominantly white and non-Hispanic. The census blocks adjacent to Provolt found only 15 persons (6.8%) in non-white ethnic categories, and 17 Hispanic persons (7.8%). In the area surrounding Sprague, there were only 15 persons (3.1%) in non-white ethnic categories, and 16 Hispanic persons (2.2%).

The 2000 census found that 15% of Josephine County's population was below the poverty threshold, while 11.6% of the population of Oregon and 11.3% of the U.S. population fall into this category (USBC 2002a). Data on poverty status are not yet available at the census block level, but data for the two block groups containing the census blocks adjacent to Provolt indicate that 14.1% of the block groups' population fall below the poverty threshold, reflecting a slightly lower rate of poverty than for the county as a whole. In the two block groups containing the census blocks adjacent to Sprague, 10.4% of the population fell below the poverty threshold, a somewhat lower rate of poverty than for the county (USBC 2002d).

There are few residences near the boundaries of the Provolt and Sprague Seed Orchards, and no disproportionate numbers of low-income or minority individuals are found there.

The 2000 census found that the census blocks adjacent to Provolt contained 20 young children (under 5 years) and 38 older children (aged 5 to 14). The census blocks adjacent to Sprague contained 29 young children and 106 older children (USBC 2002a). Section 3.6 contains more detail on the age distribution of the local populations.

Table 3.10-1. Ethnic Characteristics of Adjacent Census Blocks and Comparison Areas for Provolt Seed Orchard

Characteristic	Adjacent Census Blocks[1]		Josephine County		Oregon		U.S.	
	Number	%	Number	%	Number	%	Number	%
Total population	219	100	75,726	100	3,421,399	100	281,421,906	100
One race[2]	215	98.2	73,696	97.3	3,316,654	96.9	274,595,678	97.6
White	204	93.2	71,103	93.9	2,961,623	86.6	211,460,626	75.1
Black	0	0.0	202	0.3	55,662	1.6	34,658,190	12.3
Native American	1	0.5	949	1.3	45,211	1.3	2,475,956	0.9
Asian[3]	2	0.9	476	0.6	101,350	3.0	10,242,998	3.6
Native Hawaiian/PI3	0	0.0	83	0.1	7,976	0.2	398,835	0.1
Other[4]	8	3.7	883	1.2	144,832	4.2	15,359,073	5.5
Two or more races4	4	1.8	2,030	2.7	104,745	3.1	6,826,228	2.4
Hispanic	17	7.8	3,229	4.3	275,314	8.0	35,305,818	12.5

Source: USBC 2002a.
[1] Josephine County Census Tracts 3613 (Block 4037) and 3614 (Blocks 1000, 1023, 1024, 1025, 1026, 1027), and Jackson County Census Tract 30.02 (Blocks 2012 and 2015).
[2]"Black" = Black or African American; "Native American" = Native American or Alaska Native; "Native Hawaiian/PI" = Native Hawaiian/Other Pacific Islander; "Other" = Some other race.
[3]The 2000 Census separated the Asian and Native Hawaiian/Other Pacific Islander categories; they were previously combined under one category and are addressed as such in the CEQ and EPA Guidance.
[4]The 1997 CEQ Guidance did not address the new census categories "other" and "two or more races" for this analysis; those categories are also considered as minorities.

Table 3.10-2. Ethnic Characteristics of Adjacent Census Blocks and Comparison Areas for Sprague Seed Orchard

Characteristic	Adjacent Census Blocks[1]		Josephine County		Oregon		U.S.	
	Number	%	Number	%	Number	%	Number	%
Total population	742	100	75,726	100	3,421,399	100	281,421,906	100
One race[2]	729	98.2	73,696	97.3	3,316,654	96.9	274,595,678	97.6
White	719	96.9	71,103	93.9	2,961,623	86.6	211,460,626	75.1
Black	1	0.1	202	0.3	55,662	1.6	34,658,190	12.3
Native American	6	0.8	949	1.3	45,211	1.3	2,475,956	0.9
Asian[3]	3	0.4	476	0.6	101,350	3.0	10,242,998	3.6
Native Hawaiian/PI3	0	0.0	83	0.1	7,976	0.2	398,835	0.1
Other[4]	0	0.0	883	1.2	144,832	4.2	15,359,073	5.5
Two or more races4	13	1.8	2,030	2.7	104,745	3.1	6,826,228	2.4
Hispanic	16	2.2	3,229	4.3	275,314	8.0	35,305,818	12.5

Source: USBC 2002a.
[1] Josephine County Census Tract 3603 (Blocks 2001, 2002, 2017, and 3008).
[2]"Black" = Black or African American; "Native American" = Native American or Alaska Native; "Native Hawaiian/PI" = Native Hawaiian/Other Pacific Islander; "Other" = Some other race.
[3]The 2000 Census separated the Asian and Native Hawaiian/Other Pacific Islander categories; they were previously combined under one category and are addressed as such in the CEQ and EPA Guidance.
[4]The 1997 CEQ Guidance did not address the new census categories "other" and "two or more races" for this analysis; those categories are also considered as minorities.

4.0 Environmental Consequences

Chapter 3 introduced and described the resources that could be affected by implementing the proposed action or an alternative; Chapter 4 assesses the potential impacts. As defined in 40 CFR 1508.14, the human environment includes natural and physical resources, and the relationship of people with those resources. Accordingly, this analysis has focused on identifying types of impacts and estimating their potential significance. Table 2.6-1 in Chapter 2 summarizes the potential environmental consequences of the proposed action and alternatives.

4.1 Introduction

This chapter is organized by resources, with information presented in the same sequence as in Chapter 3, providing a logical flow for analysis of potential environmental impacts. Section 2.6 identifies the specific resources that generated concern during scoping and EIS planning, and are therefore highlighted for the decisionmaker in that chapter.

Each resource-specific subsection provides (1) a summary of the potential impacts of implementing the proposed action or an alternative; (2) the analysis methods and significance criteria for determining significance, as defined in 40 CFR 1508.27; and (3) a discussion of the potential impacts of the proposed action and each alternative. The chapter concludes with an evaluation of cumulative impacts, a discussion of mitigation measures, a discussion of unavoidable adverse impacts, an evaluation of the relationships between short-term uses of the environment versus long-term productivity, and a summary of irreversible and irretrievable commitments of resources.

The concept of "significance" used in this assessment considers both the context and the intensity or severity of the impact, as defined by 40 CFR 1508.27. The criteria used to characterize impacts are introduced at the beginning of each resource section. Significant impacts are effects that are most substantial and should receive the greatest attention in decision-making. Impacts described as minimal are identifiable and may be present, but the intensity or severity is below any threshold of concern, based on the criteria described in the specific resource discussion. Insignificant impacts result in little or no effect to the environment and cannot be easily detected; such impacts may also be referred to as negligible. If a resource would not be affected by a proposed activity, a conclusion of no impact was stated.

Impacts Common to All Alternatives

Under all alternatives, management actions not directly related to IPM, described in Section 2.1.2, would continue. These activities include administrative actions, such as facilities and equipment maintenance, which are comparable to the administrative actions described in the Medford District RMP (ROD-Administrative Actions). Orchard establishment and maintenance and buffer zone management are comparable to the silvicultural and harvest practices described for management of young stands described in the Medford District RMP. The impacts of these actions at the Provolt and Sprague Seed Orchards would be similar to the impacts described in Chapter 4 of the Final EIS for the Medford District RMP.

4.2 Air Quality

There would be insignificant impacts on air quality at and around Provolt and Sprague from vehicle emissions, from prescribed burns, and temporary very localized drift from pesticide applications. The seed orchard is located in an attainment area for all criteria

pollutants, and emissions from proposed activities would not affect any current and proposed maintenance areas within the Southwest Oregon AQCR. Air quality impacts under any alternative would be insignificant. The no action alternative would not change existing air quality at the seed orchard.

4.2.1 Analysis Approach and Assumptions

The analysis was based on a review of existing air quality in the region, information on air emission sources at both orchards, projections of emissions from the proposed IPM implementation, a review of Federal regulations, and the use of air emission factors from EPA. Current emissions were estimated using the latest available information on the types of equipment used at the seed orchard.

The significance of air quality impacts is based on Federal, state, or local regulations or standards. A significant impact would be a violation of standards, or an exposure of sensitive receptors to excessive quantities of fugitive dust or smoke. A short-term impact that did not exceed standards would not be significant. A reduction in baseline emissions would improve air quality. No standards have been established for aerial concentrations of pesticides.

4.2.2 Potential Impacts of Alternative A—Maximum Production IPM

Small increases in equipment use would minimally increase mobile source emissions. The number of vehicles and the amount of equipment would not substantially differ from existing usage at the orchards. Emissions generated from these activities would be slight, would not exceed ambient air quality standards, and would not be significant. Manual or mechanical IPM methods could produce small, localized amounts of fugitive dust, but impacts would be insignificant.

One IPM method proposed for use at Provolt and Sprague is prescribed fire, which would generate particulate matter, volatile organic compounds, nitrogen oxides, and CO. To minimize the effects of these emissions, the seed orchards would comply with local smoke management restrictions, which coordinate burns within a region to reduce cumulative impacts. To further reduce impacts, the orchards would also manage the timing, vegetation type, size of burned area, fuel arrangements and moisture, ignition techniques, and patterns of prescribed burns, while taking into account weather conditions. The orchards use prescribed fire only infrequently, on small native plant plots and occasionally to burn diseased and insect infested trees and cones (see Section 2.2.2.3) or cleared vegetation, or to occasionally remove unwanted vegetation along fence lines, irrigation ditches, or roads. Air quality impacts would be insignificant. Impacts to human health from prescribed fire are discussed in Section 4.6.2.3.

Ground vehicle and hand methods of pesticide applications could result in spray drift and volatilized chemicals. The recently conducted risk assessments (summarized in Appendix C) found soil deposition of pesticides no further than 300 feet from the orchard boundary. Options for reducing drift include using spray equipment designed to produce 200- to 800-μm-diameter particles, since particles of 100 μm or less are more likely to drift farther, and prohibiting spraying when the wind speed exceeds 6 miles per hour or is blowing toward a sensitive receptor or a nearby residence, or during an inversion. With the use of protection measures, which are an inherent part of all alternatives and are described in Section 2.3.1, impacts to air quality would be insignificant.

No other activities associated with this alternative would affect air quality.

4.2.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under the proposed action, the more restricted application procedures (see Section 2.3.3) would further reduce the risk of pesticide drift to neighboring land parcels. Impacts from mechanical and manual methods, and from prescribed fire, would be the same as those described under Alternative A. Impacts to air quality would be insignificant.

4.2.4 Potential Impacts of Alternative C—Non-Pesticide Pest Management

Under Alternative C, no biological or chemical pesticides would be used, so there would be no possibility of pesticide drift. Impacts from mechanical and manual methods, and from prescribed fire, would be similar to those described under Alternatives A and B. Impacts to air quality would be insignificant.

4.2.5 Alternative D—No Action: Continue Current Management Approach

Under Alternative D, the current insignificant air quality impacts would continue. Before BLM undertook a pesticide application, an EA would be prepared to determine potential impacts of that application. That EA would include an assessment of air quality impacts.

4.3 Geological Resources

No significant impacts to geological resources or soil are expected from the proposed action or alternatives.

4.3.1 Analysis Approach and Assumptions

Potential impacts were assessed by evaluating current conditions at the orchards (including geology, topography, soil types and properties, and hydrology) and components of the various alternatives to predict conditions occurring after implementation of these alternatives.

4.3.2 Potential Impacts of Alternative A—Maximum Production IPM

Impacts from pesticides and fertilizers applied to specified areas at Provolt and Sprague could be either impacts to the soils directly, or impacts where soils provide a pathway of potential contamination to another medium, such as water. Impacts to soils could occur through chemical changes to the soil, or physical changes (primarily compaction from heavy machinery). Chemicals could leach through the soil into the groundwater or run off to adjacent waterways. Impacts where soil provides a pathway to another medium are evaluated in the respective sections of this chapter that address the affected resources (such as water quality or human health). Section 3.0 of the risk assessment reports provides a detailed description of the potential for chemical transport through and on the soil, which can result in leaching or runoff of pesticides and fertilizers, leading to impacts on other resources.

Erosion Potential

All of the perennial streams at Provolt are surrounded by vegetative buffers between the stream and orchard production units, consisting of mature hardwoods, conifers, and

understory. Buffers of 80 to 160 feet separate the Provolt orchard units from Williams Creek and the Applegate River. Buffers of about 30 to 50 feet separate Provolt units from irrigation ditches. At Sprague, buffers of 30 to 100 feet separate orchard units from streams. At both orchards, these buffers would be maintained, with only spot treatments for noxious weeds; therefore, no increase in erosion potential due to de-vegetation is expected from any of the control methods.

Impacts from Chemical Pesticides and Fertilizers

Impacts from the application of pesticides and fertilizers to soil can be divided into two groups – those occurring from chemicals which are highly mobile in soils and have a high water solubility, and impacts from chemicals with a low mobility in soil (high adsorption rate) and are only slightly soluble in water.

Four of the pesticides proposed for application at Provolt and Sprague are highly mobile in soil – dimethoate, dicamba, hexazinone, and picloram. The risk assessment conducted for Provolt predicted that none of these chemicals would leach into the groundwater in Central Point or Kerby soils. The risk assessment conducted for Sprague predicted that three of these chemicals (dimethoate, hexazinone, and picloram) would leach to the groundwater. The application of the pesticides would not use a sufficient amount of water to move chemicals past the surface of the soil and the timing of the proposed pesticide applications would include an allowance for rain/snow prediction. (At a rate of 50 to 150 gallons per acre of water mixed with the chemical, this would be equivalent to about 0.02 to 0.05 inches of water applied to the area.) Any applied pesticides would likely remain near the surface and begin degrading, until subsequent rainfall or irrigation would move any remaining residues into the soil horizon. Mobile pesticides leaching through the soil column would not persist in the soil or bedrock, but would disperse and degrade to lower concentrations. Any impacts to geologic layers below the soils would be insignificant.

The remaining chemicals proposed for application at Provolt and Sprague have a low mobility in soil due to a higher rate of adsorption. These chemicals would likely remain near the surface of the soil and degrade over time. Most degradation occurs by microbial metabolism. Other methods of degradation include hydrolysis (the splitting of a molecule by the addition of the elements of water), photolysis (degradation by radiant energy), and chemical degradation. Except for two herbicides (hexazinone and picloram) with soil half-lives in the five to six month range, the soil half-life of most of these chemicals is less than three months. The fate and transport modeling conducted for the risk assessments (Section 3.0 of the risk assessment reports) indicated that negligible accumulation was expected.

Impacts to the soils from the application of fertilizers would be insignificant. Nitrate and other components of the fertilizers remaining in the soil would be absorbed by plants over time.

Use of vehicles at both Provolt and Sprague to apply pesticides or fertilizers could also contribute to soil compaction.

Impacts from Biological Controls

Impacts from control methods using bird and bat boxes and *B.t.* would be insignificant.

Impacts from Prescribed Fire

Prescribed fire would be utilized in small areas to remove unwanted vegetation in native plant beds and along irrigation ditches, fencelines, and roads to burn cut or cleared vegetation, insect-damaged branches and trees, insect-damaged cones, cones

not harvested for seed production, and branches and trees affected by disease. The prescribed fires are anticipated to remove much of the vegetation and organic layers on top of the soils. This would increase potential runoff and the potential for soil erosion in these localized areas. The amount of vegetation and debris left after the fires depends on the intensity and duration of the fire. A low- to medium-intensity prescribed fire would generally not burn much of the organic layer of the soil. Most of the vegetation is well adapted to fire and would recover quickly, limiting the amount of potential erosion. Other impacts to the soil include reduced porosity of the soil from fine ash particles clogging the pore spaces of the soil and, depending on the intensity of the fire, a physical or chemical crust near the upper surface of the soil. With low- to medium-intensity fires in limited areas, the short-term impacts to soils would not be significant. Erosion would be more likely to occur in areas of steeper slopes, but litter and debris remaining after the prescribed fire would somewhat reduce potential erosion. The dense root system of existing plant communities would also limit soil erosion. Areas burned would not be sufficiently large to generate substantial erosion. Any erosion occurring would not likely be transported more than a few feet and would not cause siltation of streams. The dormant seed of some unwanted plants, including some noxious weed species, would be stimulated to sprout and grow after fire.

Impacts from Cultural Controls

Soil would be compacted by machinery during mowing. The degree of compaction would depend on soil moisture conditions. All of the soils at Provolt and Sprague are vulnerable to compaction when the soil is wet. Compaction of soil would increase the amount of runoff and the potential for erosion.

4.3.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Impacts on soil and geologic resources from this alternative would not be significantly different than under Alternative A. Limitations on pesticide use could decrease the potential for impacts to soil chemistry from pesticide residues retained in the soil horizon. Impacts to soils from biological controls and prescribed fires would be the same as under Alternative A. Impacts to geological resources and soils occurring from implementation of Alternative B would be insignificant.

4.3.4 Potential Impacts of Alternative C—Non-Pesticide Pest Management

Impacts to soil chemistry from pesticide residues would not be an issue under this alternative. As under Alternative A, impacts to the soils from the application of fertilizers would be insignificant. Depending on the frequency and timing of mechanical, hand, and cultural methods of controlling pests, soil compaction could be somewhat greater compared to Alternatives A or B.

4.3.5 Potential Impacts of Alternative D—No Action: Continue Current Management Approach

Use of non-pesticide methods would continue under this alternative, with no projected change in impacts from biological, cultural, or prescribed fire control methods. Potential soil impacts from chemical methods of control would be reviewed on a case-by-case basis if pesticide chemicals were proposed for use.

4.4 Water Resources

The primary water resource concern relating to the proposed IPM activities at Provolt and Sprague Seed Orchards is how pest control methods, particularly the use of pesticides, would affect the surface water and groundwater from chemical transport and storage, as well as the resulting potential effects on downstream water users (primarily drinking water) and aquatic ecosystems.

Potential effects to water resources of most pesticide and fertilizer use are expected to be minimal to negligible, based on the conclusions of the risk assessments (summarized in Appendix C). Protection measures incorporated into all of the alternatives are expected to minimize the potential water quality impact from runoff and spills. These measures are listed in Section 2.3.1. All of the alternatives include monitoring the use and effectiveness of these measures, and adjusting application procedures based on monitoring results.

The risk assessment estimated pesticide and fertilizer concentrations in surface water and groundwater; see Tables C-1 to C-6 in Appendix C. The potential impacts of surface water and groundwater contamination to human health, such as from the ingestion of drinking water or contaminated fish, are addressed in Section 4.6 (Human Health and Safety). Potential impacts to the aquatic ecosystem, including special status species, are addressed in Section 4.7 (Biological Resources). Because drainage patterns and natural topography of the orchards and surrounding areas would not be affected by the proposed IPM activities, there would be no adverse impacts to floodplains. Therefore, floodplains are not discussed further in this section.

4.4.1 Analysis Approach and Assumptions

The major public scoping concern regarding water quality is the potential for pesticide contamination. Computerized fate and transport modeling was conducted to estimate concentrations of pesticides in the surface water and groundwater. The Groundwater Loading Effects of Agricultural Management System (GLEAMS) model, which models pesticide behavior in soils and water, was used to characterize the leaching and runoff behavior of the pesticides. This model used the best available data for orchard soil, watershed, and pesticide-use characteristics. Section 3.2.1 of the risk assessment reports provides a detailed description of the model, input parameters and assumptions. In summary, there are four major components to GLEAMS: hydrology, erosion, nutrients, and pesticides. Factors considered included:

- Soil organic matter content and pH;
- Soil porosity and water retention characteristics;
- Pesticide decomposition rates and tendencies to be adsorbed;
- Pesticide solubility and vapor pressure;
- Pesticide application rates, methods, and timing;
- Surface and subsurface hydrological characteristics; and
- Local precipitation, irrigation, and climatic conditions.

To further distinguish the typical and maximum scenarios beyond any application rate and frequency differences listed in Table 2.2-1, the results of GLEAMS were handled as follows: In the typical scenarios, the mean of the 10 highest runoff concentrations over the modeling period was selected for use in the risk assessment. In the maximum scenarios, the single highest runoff concentration was used in the risk assessment.

The GLEAMS model predicted runoff of chemicals and water as they might be measured at the edge of each orchard unit. The Provolt and Sprague seed orchard units generally have significant areas of untreated field edges and well-vegetated buffers between treated

acreage and receiving streams (between approximately 30 and 100 feet). These untreated intervening areas (collectively termed "buffer zones") play a major role in reducing the amount of chemicals that actually reach stream water. The seed trees and well-managed surface vegetation present at the orchards make it more similar to a well-managed forest and, although runoff does reach streams, it is mostly via subsurface shallow flow. In addition, both the climate, which is characterized by fairly even precipitation, and surface conditions at the seed orchards are conducive to percolation rather than direct runoff of rainfall. As a result, streamflow from the orchard areas also is primarily due to subsurface flow.

It should be noted, however, that the orchards rely heavily on irrigation during the dry season (mid-May to mid-October). At Provolt, irrigation water is pumped from a springwell in Orchard Unit 3 to irrigate all orchard units except 15, 16, and 17 with a Microjet system; water is sprayed to the root area of each tree. Broadcast sprinklers are used for irrigating units 15, 16, and 17; these sprinklers spray water over the entire area. At Sprague, irrigation water is pumped from two wells. Water from Well #1, near the lake, is used for the irrigation of 22 acres of trees. Water from Well # 3 is used to irrigate 53 acres of trees and grass gardens. Given the dryer climate in southwestern Oregon, the orchards rely heavily on irrigation during portions of the year; heavy use of irrigation water can contribute substantially to potential leaching and runoff, although the orchards are careful not to irrigate too much because it can result in more stress and root diseases.

To account for the attenuating affect of the buffer zones, the USGS Method of Characteristics model was used to estimate concentrations in groundwater and, for Provolt, segments of Williams Creek above and below Bridge Point Ditch, Spencer Ditch, segments of Bridge Point Ditch above and below the confluence with Spencer Ditch, Laurel Hill Ditch, the pond, and the Applegate River. Estimated concentrations in surface water for Sprague included each stream segment on the orchard, the main tributary to Jump-off Joe Creek south of the seed orchard, and Jump-off Joe Creek. These values for Provolt and Sprague are presented in Tables C-1 and C-2, respectively, of Appendix C to this EIS, and can be considered to represent 24-hour average concentrations. For groundwater, the GLEAMS simulations calculated estimates of the mass per unit area of each chemical leaching below the rooting zone. Estimated groundwater concentrations are presented in Tables C-3 and C-4 in Appendix C.

Finally, the Exposure Analysis Modeling System (EXAMS) model was used to predict downstream concentrations in Bridge Point Ditch (where three orchard roads converge at a crossing) and Williams Creek (where Highway 238 crosses) at Provolt, if an accidental spill of pesticide concentrate or tank mix were to occur; and at the Lake CASSO spillway (near south end of the lake) and an intermittent stream near the southwest corner of Orchard Unit 53 at Sprague. Estimated concentrations in groundwater in the vicinity of the domestic well near the Provolt orchard office, and in the vicinity of Well #2 on the southeastern corner of Sprague seed orchard property, also were estimated.

4.4.2 Potential Impacts of Alternative A—Maximum Production IPM

4.4.2.1 Groundwater

Chemical contamination of groundwater would depend on the extent to which pesticides and fertilizers may leach through the soils into the groundwater and the depth of the water table. The extent of leaching would, in turn, depend on the physical properties of the soils affected (permeability, organic matter, percent clay, depth of soil horizons, and properties of geological materials underlying the soils) and the chemical properties of the pesticide or fertilizer (primarily its water solubility and partition coefficient – ratio of chemical absorbed to the soil to the amount in soil solution).

In both the typical and maximum scenarios (see Section 4.6.1 for descriptions of scenarios), the same pesticides were seen to leach below the rooting zone at both Provolt and Sprague: dimethoate, hexazinone, and picloram. Even in the maximum scenarios, the estimated groundwater concentrations at Provolt and Sprague are below levels that would be associated with any risks to human health (see Table 6-1 of the risk assessment reports), and movement of groundwater away from the orchard units would lead to even lower concentrations, due to dispersion, adsorption, and degradation. Therefore, impacts to groundwater would be negligible.

The risk assessment predicted that phosphate from the application of monoammonium phosphate would leach to the groundwater at Provolt and Sprague, and that nitrogen from the application of ammonium nitrate would leach to the groundwater at Sprague. Impacts to the groundwater would be negligible, however, particularly given reduced concentrations in groundwater as it moves offsite away from the orchard units and becomes further diluted. No human health risks were associated with these concentrations for exposure through drinking water (see Section 4.6 and Appendix C).

Impacts to groundwater (specifically, drinking water) from an accidental spill of a container of pesticide concentrate or fertilizer at the mixing area are addressed in Section 4.6.

All of the alternatives would include an on-site water quality monitoring program. Groundwater from nearby orchard domestic wells would be monitored in the event of a spill to identify any groundwater contamination and the resulting pesticide concentration(s). Periodic monitoring of the four groundwater monitoring wells at Sprague, located in the greenhouse wastewater field, also would be conducted to identify concentrations of any greenhouse wastewater pesticides or fertilizers in the local groundwater. Detailed information on the proposed Monitoring Plan for Provolt and Sprague is found in Appendix B.

Biological and cultural control methods, such as mechanical methods, include no activities that would adversely affect groundwater. *B.t.*, a biological insecticide, is a naturally occurring soil bacteria. Applications of *B.t.* formulations do not increase levels of *B.t.* in soil. *B.t.* spores and crystals persist for a relatively short time. Like all soil microbes, *B.t.* does not percolate through the soil and its presence is confined to the top 10 inches of soil. Thus no groundwater contamination concerns are present (EPA 1998a).

4.4.2.2 Surface Water

Surface water contamination could potentially occur from the use of chemical pesticides or fertilizers and, to a lesser extent, from implementing biological and cultural IPM methods and prescribed fire. Each of these is discussed below. Potential impacts from pesticide and fertilizer use were analyzed for both normal applications and accidental spills.

Impacts from Pesticide and Fertilizer Application

Surface water contamination could occur indirectly from runoff (overland flow) of pesticides or fertilizers after application. This occurrence would depend largely on the characteristics of the soil, including the amount of vegetation present, the slope of the affected area, and the chemical applied. For example, if a chemical adsorbs well to the soil, it will tend to stay in the soil and be broken down in place. A chemical that does not adsorb to the soil could be washed away via soil surface or subsurface movement with irrigation or rainwater, and would more likely be a potential contaminant. In general, the risk assessment predicted low surface runoff losses of pesticides and fertilizers at both the Provolt and Sprague seed orchards (see Tables C-1 and C-2 in Appendix C). The primary reasons for low runoff, as mentioned previously, include the extensive buffer

zones between treated acreage and receiving streams which significantly reduce the amount of chemicals that actually reach stream water. Timing of chemical applications in relation to rainfall and irrigation is also important. Longer time periods between irrigation and pesticide applications reduce the concentrations of the pesticide in the water, because of pesticide degradation. Some runoff would reach streams by interflow (flow just beneath the surface) where slope is sufficient.

The highest concentration predicted by the risk assessment in the maximum scenario was about 0.6 mg/L for nitrate (from fertilizers) in on-site natural drainage segments at Sprague, and even lower concentrations were predicted to reach non-first order streams at Sprague. Concentrations were even lower at Provolt, with the highest value in the maximum scenario (0.00065 mg/L nitrate) predicted for an on-site ditch segment. Far lower concentrations of pesticides were found in Williams Creek and the Applegate River. No significant change in the potential for sediment delivery to surface water is expected as a result of vegetation control using chemical herbicides.

Measures are taken to ensure that no off-target drift occurs during pesticide application, including drift to surface water. Spray nozzles are specifically designed to minimize drift. Buffer strips around streams and restrictions on spraying based on wind speed also would reduce the chance of drift reaching sensitive areas, such as streams. Equipment washing would be conducted in designated areas where the wash water would not contaminate surface water or groundwater. Section 2.3.1 lists the protection measures inherent in the proposed action and all alternatives.

As mentioned earlier in this document, both Provolt and Sprague propose to conduct water quality monitoring as part of the proposed IPM program to check for contamination and ensure protection. The proposed plan (Appendix B) encompasses the following components: implementation monitoring to document that design features have actually been implemented; effectiveness monitoring to document how well the design features have performed in avoiding the introduction of pesticides to the surface and groundwater systems; validation monitoring which would use the effectiveness data to validate the water quality modeling; and compliance monitoring, to document domestic water quality and pesticide fate in terms of irrigation effluent.

Impacts from Accidental Chemical Spill

Chemical contamination of surface water could occur in the case of an accidental pesticide or fertilizer spill during loading, transport, or application.

The EXAMS modeling predicted that maximum residues from spills into the larger perennial streams or intermittent streams at Provolt would reach the Applegate River in less than one hour. Results of the modeling for Sprague show that the maximum residues from spills into the larger perennial streams would reach the main tributary to Jump-off Joe Creek within an hour. In addition, the residues at Sprague would take approximately three hours to reach maximum concentrations in the nearby portions of Jump-off Joe Creek.

In the event of an accident or spill, members of the public and workers may be exposed to greater amounts of a pesticide than from normal applications. These risks are discussed in Section 4.6.

Impacts from Biological and Cultural Methods

Potential effects to surface water resources from biological methods, such as bird and bat boxes and *B.t.* in field runoff, would be minimal. Even if it reached the streams, *B.t.* is not known as an aquatic bacterium and is not expected to proliferate in aquatic habitats. It is also considered very non-toxic, especially when it is used in terrestrial applications.

Potential effects to water resources from cultural methods, such as sedimentation, also would be minimal. While soil-disturbing operations and/or soil compaction caused by the use of heavy machinery can lead to increased runoff and stream sedimentation, very little sediment, or bacteria in the case of biological methods, is likely to reach both orchards' onsite streams due to the extensive buffers of untreated vegetation. During periods of heavy rain, there is some potential for sediment or bacteria residues to be released into the local streams; however, concentrations are still expected to be minimal.

Impacts from Prescribed Fire

Potential effects to water resources from prescribed fire would be minimal. Fire can remove the top vegetation and organic layers of soils, which could increase the potential for runoff and soil erosion (particularly in areas of steeper slope). However, any erosion would not likely be transported more than a few feet and is not expected to cause siltation of streams. Litter and debris remaining after the prescribed fire would serve to reduce potential erosion, as would the dense root system of existing plant communities. Finally, the burn areas would not be sufficiently large to generate substantial erosion.

4.4.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Impacts to surface water and groundwater would be the same under the proposed action as in Alternative A for biological and cultural control methods. Impacts to water resources from pesticide and fertilizer application would be less than those identified in Alternative A because limitations incorporated into project design would control the potential for runoff or drift (see Section 2.3.3).

4.4.4 Potential Impacts of Alternative C—Non-Pesticide Pest Management

Under this alternative, potential runoff and leaching of pesticides to water would not be a concern since no pesticides would be applied. Fertilizers could be present in runoff, with the same impacts as under Alternative A. Overall impacts would be less than Alternatives A or B. Greater reliance on cultural and non-pesticide biological methods may result in slightly greater potential for runoff and sedimentation in streams. However, impacts would be negligible due to the extensive buffers of untreated vegetation.

4.4.5 Potential Impacts of Alternative D—No Action: Continue Current Management Approach

Use of non-pesticide methods would continue under this Alternative, with no projected change in impacts. Any potential use of pesticide methods of control would require a separate EA each time a specific use was proposed. Impacts would be similar to Alternatives A or B (depending on project-specific details), although perhaps slightly less since potentially fewer chemicals would likely be applied in the orchard on an annual basis, given the schedule limitations, costs, and administrative demands of preparing EAs on a case-by-case basis.

4.5 Land Use

Land use impacts are related to changes in the productive use of land as the result of an action. Insignificant impacts on land use are projected for the proposed action and all alternatives.

4.5.1 Analysis Approach and Assumptions

The most recent information about surrounding land uses—including aerial photos, census data, and scoping comments—was used to determine current land uses and evaluate potential impacts. A significant impact to land use would be a permanent or long-term (several years) change in how a parcel could be used. Neither the proposed action nor any alternative includes activities that would change existing land use at the seed orchard or neighboring parcels directly. The potential for indirect impacts, from off-site transport of chemicals, was evaluated by reviewing the conclusions of the risk assessments (summarized in Appendix C).

4.5.2 Potential Impacts of All Alternatives

No direct land use impacts are predicted under any alternative.

The risk assessment predicted negligible pesticide drift to neighboring land parcels (shown in Figures 3.5-1 and 3.5-2) under Alternative A (Maximum Production IPM), which emphasizes aggressive pest management and has the highest potential for use of pesticide chemicals. The potential for indirect land use impacts from pesticide transport to neighboring land units is even smaller for Alternatives B, D, and C, with the probability for impact decreasing successively under each alternative. Alternative B (IPM with Environmental Protection Emphasis, the proposed action), includes limitations (see Section 2.3.3) that would reduce the potential for offsite pesticide transport to neighboring land parcels, below the levels predicted for Alternative A. Under Alternative D (No Action), a NEPA document would be prepared prior to each pesticide use. Any potential impacts to land use from pest management under this alternative would be identified in each project-specific NEPA document. It is likely that potential impacts would be insignificant, similar to those from Alternatives A or B, depending on the details of the pesticide application. Finally, under Alternative C (Non-Pesticide Pest Management), no biological or chemical pesticides would be used, so there would be no possibility of pesticide transport to nearby land parcels.

Biological, cultural, and prescribed fire control methods under all alternatives would have insignificant land use impacts at Provolt and Sprague, and to neighboring parcels.

4.6 Human Health and Safety

Human health impacts as a result of any of the pest control methods could include chemical toxicity as a result of exposure to chemical pesticides, injury during use of cultural methods, and injury or smoke exposure during use of prescribed fire. No health impacts were identified for biological control methods or fertilizers. A quantitative human health risk assessment evaluated the potential effects to members of the public and seed orchard workers from using chemical pesticides and fertilizers under Alternative A. No risks to members of the public were predicted for non-accident exposures, but some pesticides (chlorpyrifos, diazinon, dimethoate, permethrin, propargite, dicamba, and hexazinone) were predicted to present risks to some workers in certain situations. In response to these identified risks, Alternative B was designed, which incorporates limitations on chemical pesticide use that reduce these estimated workers risks to negligible levels. Alternative C does not include the use of pesticides, and Alternative D would result in less frequent pesticide application.

No risks are predicted for members of the public from non-accident exposure to chemical pesticides under any of the alternatives. Under Alternatives A, B, and D, an accidental spill into a stream could result in surface water that would be unsafe for drinking or fishing. There are potential risks to workers from seven of the proposed pesticides under

Alternative A, and no predicted risks to workers from pesticides under Alternatives B, C, and D. Potential impacts on human health due to injury, heat, fire, and smoke are possible under all the alternatives, but the most likely of these impacts are temporary (muscle strain, eye and throat irritation due to smoke). These risks are slightly increased under Alternative D (no action), since less use would be made of pesticides, and increase further under Alternative C, since these methods would take the place of all pesticide use.

4.6.1 Analysis Approach and Assumptions

Risks from biological, cultural, and prescribed fire methods were evaluated qualitatively, based on potential types of injuries or health effects associated with the specific method, and the frequency of such injuries or effects at Provolt and Sprague in the past.

To assess risks from use of chemical pesticides and fertilizers proposed under Alternative A, quantitative risk assessments were conducted that estimated the risks to members of the public and workers as a result of using the proposed pesticides and fertilizers at Provolt and Sprague Seed Orchards. The supporting record for this EIS contains the full risk assessments; a summary is provided in Appendix C, including tables summarizing the modeling predictions for surface and groundwater concentrations and drift deposition. The human health risk assessment methodology is summarized briefly in the following paragraphs. Detailed information on inputs, methods, assumptions, and outputs can be found in Sections 4.0, 5.0, and 6.0 of each risk assessment report.

Computerized fate and transport modeling was conducted to estimate concentrations of pesticides and fertilizers in environmental media at the point of exposure. Section 4.4.1 describes the water modeling used to estimate concentrations in groundwater, irrigation ditches, Williams Creek, the Applegate River, and the onsite pond at Provolt; and groundwater, on-site streams, Jump-off Joe Creek and its main tributary, and Lake CASSO (the onsite pond) at Sprague. AgDRIFT was used to estimate off-target pesticide drift from applications using a tractor-pulled spray rig with a boom. Field studies reported in the published literature provided the basis for estimates of drift from other ground-based pesticide application methods. Section 3.0 in both risk assessment reports provides details of the models, their inputs, and the results obtained.

The risk assessment employed the three principal analytical elements that the National Research Council (1983) described and EPA (1989, 2000a) affirmed as necessary for characterizing the potential adverse health effects of human exposures to existing or introduced hazards in the environment: hazard assessment, exposure assessment, and risk characterization.

The risk assessment addresses risks from fertilizers and 14 pesticide active ingredients[1], as well as "other" ingredients in the pesticide formulations, formerly termed "inert" ingredients.[2]

Human Health Hazard Assessment

Hazard assessment requires gathering information to determine the toxic properties of each chemical and its dose-response relationship. Human hazard levels are derived primarily from the results of laboratory studies on animals. Toxic effects were divided into two categories, with different analytical approaches used: noncarcinogenic effects

[1] The biological insecticide B.t. and Safer® Insecticidal Soap were not included in the quantitative risk assessment. Potential environmental impacts are evaluated separately for these two control methods. See specific discussion at the end of Section 4.6.1.
[2] The risk assessment evaluated the formulations that are expected to be used. It is possible that other formulations of the same active ingredients may be substituted at times. The risks from other formulations containing the same active ingredients would be similar to the risks predicted in the risk assessment.

(for example, toxicity to the liver or nervous system) and carcinogenicity. The goal of the hazard assessment is to identify acceptable doses for noncarcinogens, and identify the cancer potency of potential carcinogens.

For noncarcinogenic effects, it is generally assumed that there is a threshold level, and that doses lower than this threshold can be tolerated with little potential for adverse health effects. EPA has determined threshold doses for many chemicals; these are referred to as reference doses (RfDs). The oral RfD is an estimate of the highest possible daily oral dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime. The uncertainty of the estimate usually spans about one order of magnitude. RfDs are expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg/day).

Data on carcinogenic potential were reviewed for each chemical. Acephate, permethrin, and propargite are considered possible human carcinogens; and chlorothalonil and hexachlorobenzene (a contaminant in picloram) are considered to be probable human carcinogens. For these compounds, cancer slope factors that have been calculated by EPA or other appropriate sources are used in this risk assessment. The cancer slope factor of a chemical represents the probability that a 1-mg/kg/day chronic dose would result in formation of a tumor, and is expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

The RfDs and cancer slope factors used in this risk assessment are summarized in Table 4.6-1.

Table 4.6-1. Toxicity Endpoints

Chemical	RfD (mg/kg/day)	Dermal Absorption (%)	Cancer Slope Factor (per mg/kg/day)
Acephate	0.004	0.4 (1-hr)	0.0087
Chlorothalonil	0.015	0.15	0.00766
Chlorpyrifos	0.0003	1.78 (4-hr)	NA[a]
Diazinon	0.0002	2	NA
Dicamba	0.045	10	NA
Dimethoate	0.0005	11	NA
Esfenvalerate	0.02	3 (8-hr)	NA
Glyphosate	2	1.42 (24-hr)	NA
Hexazinone	0.05	1	NA
Horticultural oil	1	1	NA
Permethrin	0.05	1.7	0.016
Picloram Hexachlorobenzene	0.2 NA	0.2 23	NA 1.7
Propargite	0.04	14.5 (8-hr)	0.201
Triclopyr	0.5	1.65 (8-hr)	NA
Inert Ingredients Cyclohexanone Ethylbenzene Light aromatic solvent naphtha Xylene	 5 0.1 0.02 2	 10 3.4 (4-hr) 10 3.9 (4-hr)	 NA NA NA NA
Nitrate	1.6	NA	NA

[a]NA = Not applicable

Human Health Exposure Assessment

Exposure assessment involves estimating doses to persons potentially exposed to the pesticides or fertilizers. In the exposure assessment, dose estimates were made for typical, maximum, and accidental exposures. These exposures are defined as follows:

- *Typical:* For this risk assessment, the word "typical" refers to a level of exposure within a scenario, and does not indicate whether the scenario itself is likely to occur. Typical exposure reflects the average dose an individual may receive if all exposure conditions are met. Typical exposure assumptions include the application rate usually used at the seed orchard, usual number of applications per year, the average of the ten highest values for chemical concentrations predicted to be present in runoff over a 10-year period of annual typical applications, and other similar assumptions.

- *Maximum:* Maximum exposure defines the upper bound of credible doses that an individual may receive if all exposure conditions are met. Maximum exposure assumptions include the maximum application rate according to the label, maximum number of applications per year, the highest chemical concentration predicted to be present in runoff over a 10-year period of annual maximum applications, and other similar assumptions.

- *Accidental:* The possibility of error exists with all human activities. Therefore, it is possible that during seed orchard operations, accidents could expose individuals to unusually high levels of pesticides or fertilizers. To examine these potential health effects, several accident scenarios were evaluated for health effects to members of the public and workers.

It is important to note that these exposure scenarios estimate risks from clearly defined types of exposure. If all the assumptions in an exposure scenario are not met, the dose would differ from that estimated here, or may not occur at all.

For members of the public, the exposure scenarios analyzed in this risk assessment consist of the following:

- Ingestion of groundwater.

- Ingestion of water from Applegate River or Williams Creek at Provolt; or from the intermittent stream draining the northwest section of Sprague at the point where two main eastern branches converge south of Orchard Unit ARB3. None of these are known sources of drinking water for local residents.

- Ingestion of fish from Applegate River, Williams Creek, or the pond near the seed orchard office at Provolt; or from Jump-off Joe Creek or the onsite pond (Lake CASSO) at Sprague.

- Ingestion of deer and quail hunted near orchard lands.

- Ingestion of Canada goose hunted near orchard lands (Provolt only).

- Ingestion of blackberries.

- Dermal exposure to insecticide/fungicide drift residues on vegetation, or herbicide treatment residues on vegetation, during recreational hiking on orchard lands.

- Dermal exposure to residues on dogs following recreational use of site.

The categories of workers evaluated in this risk assessment for occupational exposure to pesticides are as follows:

- High-pressure hydraulic sprayer mixer/loader/applicator.
- Hydraulic sprayer with hand-held wand mixer/loader/applicator.
- Tractor-pulled spray rig with boom mixer/loader/applicator.
- Backpack sprayer mixer/loader/applicator.
- Hand-held wick mixer/loader/applicator.
- Broadcast fertilizer spreader loader/applicator.
- Irrigation system maintenance personnel.

Several accidental exposure scenarios were also evaluated:

- Ingestion of groundwater after a spill of concentrate.
- Ingestion of fish and water containing runoff from a spill of concentrate.
- Ingestion of fish and water downstream of a spill of tank mix directly into a stream.
- Spill of pesticide concentrate onto worker's skin.
- Spill of pesticide mixture onto worker's skin.
- Spray of worker with tank mix of pesticide.

Human Health Risk Characterization

Characterizing risk that results from different levels of exposure illustrates a principal tenet of risk assessment, set down by Paracelsus in the 16th century:

> All substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy.

Toxicity is a chemical-specific property that does not vary based on the exposure situation; it is determined by a substance's ability to cause effects at certain doses. That is why the exposure analysis is required, to determine whether any exposures will occur at the levels associated with those effects: even a highly toxic chemical can be "safe" at very low levels of exposure, while a relatively nontoxic chemical can cause effects if the exposure is sufficiently high.

In this risk assessment, the potential noncarcinogenic risks were evaluated by comparing the representative doses (estimated in the exposure assessment) with the RfDs (identified in the hazard assessment). All the RfDs used in this risk analysis take into account multiple exposures over several years and represent acceptable dose levels. The comparison of dose to RfD consists of a simple ratio, called the hazard index:

$$\textit{Hazard Index} = \textit{Estimated Dose (mg/kg/day)} \div \textit{RfD (mg/kg/day)}$$

If the estimated dose does not exceed the RfD, the hazard index will be one or less, indicating the dose is within the range generally considered to pose no adverse effects to humans.

A dose estimate that exceeds the RfD, although not necessarily leading to the conclusion that there will be toxic effects, clearly indicates a potential risk for adverse health effects. Risk is presumed to exist if the hazard index is greater than one. However, comparing one-time or once-a-year doses (such as those experienced by the public or in an accident) to RfDs derived from long-term studies with daily dosing tends to exaggerate the risk from those infrequent events.

To estimate cancer risk, the dose is averaged over a lifetime (75 years), and multiplied by the chemical's cancer slope factor. The resulting cancer probability is compared to a benchmark value of one in one million, a value commonly accepted in the scientific

community as representing a cancer risk that would result in a negligible addition to the background cancer risk of approximately one in four in the U.S.

Analysis of B.t., Imidacloprid, and Safer® Insecticidal Soap

B.t. is a rod-shaped bacterium that produces a protein (a delta endotoxin) that is toxic to insects. *B.t.* is a naturally occurring microorganism that is found in the soil. According to EPA, no known mammalian health effects have been demonstrated in any infectivity/pathogenicity study (EPA 1998a). Some strains of *B.t.* have the potential to produce various toxins that may exhibit toxic symptoms in mammals; however, the manufacturing process includes monitoring to prevent these toxins from appearing in products. In terms of risks to seed orchard application or re-entry workers, EPA stated that "the potential for eye, dermal, and inhalation exposure to mixers, loaders and applicators does exist. The label for *Bacillus thuningiensis* based products may recommend wearing gloves, goggles, and a dust mask or equivalent pulmonary tract covering. However, because of a lack of mammalian toxicity, the risk from occupational exposure is minimal." Seed orchard personnel would follow all label guidelines and recommendations to minimize occupational exposure, as with all other pesticides proposed for use in the IPM program. In terms of risk to members of the public, anyone contacting soil is likely to have been dermally exposed to naturally occurring *B.t.* (EPA 1998a). The mechanism of its pesticidal action is unique to the gut membrane of insects, with no equivalent or similar mechanism in humans or other mammals. Its 50-year use history in agricultural and community pest (mosquito, gypsy moth, other) control projects with no known adverse effects in members of the public (EPA 1998a) also supports the conclusion that there would be no significant impacts from seed orchard use.

Imidacloprid is a chloronicotinyl insecticide. It is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. Movement of imidacloprid is restricted to the vascular system of the tree; therefore, there is no potential for exposure to members of the public following application. Applicator exposure is highly unlikely due to the capsulized form of the product, but could occur in the accidental situation in which a capsule breaks open and a worker is dermally exposed to the contents. The label for conifer seed tree use of Imicide® states that the 3-mL size capsules would be used; each contains 332.1 mg a.i. (Mauget 2003). Assuming that 25% of the spilled amount remained on the skin, and using a dermal absorption factor of 7.2% (EPA 2003), a dose to a 71.8-kg adult would be 0.083 mg/kg. Comparing this to an acute RfD (appropriate for one-time accidental exposures) of 0.14 mg/kg (EPA 2003), the resulting hazard index is 0.60, indicating no risk to workers from this accident scenario. Imicide has demonstrated no evidence of carcinogenicity in studies in rats and mice (EPA 2003).

Safer® Insecticidal Soap contains potassium salts of fatty acids. Fatty acids are naturally occurring compounds. The safety of this class of compounds is exemplified by the fact that they are permitted for direct addition to food for human consumption by the U.S. Food and Drug Administration (21 CFR 172.863). They exhibit low acute toxicity by the oral route of exposure, but can be irritating to the skin or eyes (EPA 1992).

No significant health effects are expected for either workers or members of the public from seed orchard use of *B.t.*, Imicide®, or Safer® Insecticidal Soap.

Adjuvants and Surfactants

In some cases, surfactants or adjuvants may be added to formulated pesticide products to improve their effectiveness or minimize handling and application problems. The seed orchards will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000b). If a surfactant or adjuvant

that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical would be evaluated before a use determination is made.

4.6.2 Potential Impacts of Alternative A—Maximum Production IPM

4.6.2.1 Biological Control Methods

No significant impacts on human health are expected from the use of biological controls, including the use of the biological insecticide *B.t.* and the use of bird and bat boxes to attract insect-eaters.

4.6.2.2 Chemical Control Methods

The assumptions used in the risk assessment regarding application rates, frequency, and areas potentially treated correspond to the details of Alternative A. Hazard indices and cancer risks for each chemical and scenario are presented in tables in Section 6.0 of the risk assessment reports. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.6-2.

Members of the Public

For members of the public, hazard indices were less than one for all typical and maximum exposure scenarios, and cancer risks were all less than 1×10^{-6} (one in one million), ranging up to 8.98×10^{-10} (8.98 in ten billion) at Provolt and 2.98×10^{-10} (2.98 in ten billion) at Sprague. Therefore, no significant risks are predicted for members of the public.

There is a block of private property outside the eastern border of the Provolt Seed Orchard. Risks from seed orchard pesticide drift to users of these properties would be no greater than risks from the drift calculations that were applied to recreational hikers or blackberry harvesters, which do not exceed the levels of concern. That is, all hazard indices are less than one and all cancer risks are less than one in one million for these scenarios.

Workers

For typical scenarios, all worker hazard indices are less than one, with the following exceptions:

- A hydraulic sprayer with hand-held wand mixer/loader/applicator applying dimethoate, and
- A backpack sprayer applying dimethoate, permethrin, propargite, or dicamba.

In the maximum scenarios, the hazard indices exceed one for the following workers:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon;
- A hydraulic sprayer with hand-held wand mixer/loader/applicator applying diazinon (Provolt only) or dimethoate;
- A backpack sprayer applying dimethoate, permethrin, propargite, dicamba, or hexazinone; and

Table 4.6-2. Summary of Scenarios with Predicted Human Health Risks Under Alternative A

Chemical	Scenario	Risk
Risks to Members of the Public		
None	None	None
Risks to Workers		
Chlorpyrifos	Irrigation system maintenance worker (following high-pressure hydraulic sprayer application)	Provolt: Hazard index = 2.92 (maximum) Sprague: Hazard index = 8.77 (maximum)
Diazinon	High-pressure hydraulic sprayer	Hazard index = 3.89 (maximum)
	Hydraulic sprayer with hand-held wand (Provolt only)	Provolt: Hazard index = 1.61 (maximum)
	Irrigation system maintenance worker (following high-pressure hydraulic sprayer application)	Hazard index = 27.3 (maximum)
Dimethoate	Hydraulic sprayer with hand-held wand	Provolt: Hazard index = 6.13 (typical) and 16.1 (maximum) Sprague: Hazard index = 3.07 (typical) and 8.05 (maximum)
	Backpack sprayer	Provolt: Hazard index = 4,220 (typical) and 11,000 (maximum) Sprague: Hazard index = 2,110 (typical) and 5,540 (maximum)
Permethrin	Backpack sprayer	Provolt: Hazard index = 1.34 (typical) and 4.04 (maximum) Sprague: Hazard index = 1.35 (typical) and 4.05 (maximum)
Propargite	Backpack sprayer	Provolt: Hazard index = 8.56 (typical) and 15.2 (maximum) Cancer risk = 2.54×10^{-5} Sprague: Hazard index = 1.25 (typical) and 2.05 (maximum) Cancer risk = 1.74×10^{-5}
Dicamba	Backpack sprayer	Hazard index = 1.64 (typical) and 3.29 (maximum)
Hexazinone	Backpack sprayer	Hazard index = 1.06 (maximum)

- An irrigation system maintenance worker encountering residues of chlorpyrifos or diazinon.

The estimated cancer risk to backpack sprayers applying propargite is 2.54 in 100,000 at Provolt and 1.74 in 100,000 at Sprague, in both cases exceeding the standard point of departure of one in one million. All other cancer risks to workers were less than one in one million.

Accidents

For a spill of a container of pesticide concentrate at the mixing area, no risks to the public from drinking groundwater contaminated by leached chemical were predicted. If precipitation caused runoff of spill residues to surface water from the spill site, risks were predicted from chlorpyrifos and diazinon to adults and children consuming fish or surface water from the Applegate River at Provolt, and from diazinon to children

consuming fish or surface water from Jump-off Joe Creek at Sprague. All estimated cancer risks were less than one in one million.

At Provolt, for a spill of an application tankload of mixed pesticide into Bridge Point Ditch, risks to the public from drinking water and eating fish from the Applegate River are predicted for chlorpyrifos, diazinon, propargite, and chlorothalonil. All cancer risks are less than one in one million. For a spill of an application tankload of mixed pesticide into Williams Creek, risks to the public from drinking water and eating fish from the Applegate River are predicted for chlorpyrifos, diazinon, propargite, and chlorothalonil. All cancer risks are less than one in one million.

At Sprague, for a spill of an application tankload of mixed pesticide from the orchard road that crosses the Lake CASSO spillway, risks to the public from drinking water and eating fish from Jump-off Joe Creek are predicted for chlorpyrifos, diazinon, and chlorothalonil. All cancer risks are less than one in one million. For a spill of an application tankload of mixed pesticide from the orchard road crossing an intermittent stream near the southwest corner of Orchard Unit 53, risks to the public from drinking water and eating fish from Jump-off Joe Creek are predicted for chlorpyrifos, diazinon, and chlorothalonil. All cancer risks are less than one in one million.

In the accident scenario in which a worker spills liquid pesticide concentrate on the skin, hazard indices exceed one (ranging up to 10,100 for dimethoate) for handling acephate implants that were spilled on, and for dimethoate, esfenvalerate, permethrin, chlorothalonil, and dicamba. Estimated cancer risks were all less than one in one million.

In the accident scenario in which a worker spills tank-mixed diluted pesticide on the skin, hazard indices are greater than one for chlorpyrifos, diazinon, dimethoate, and dicamba. All estimated cancer risks are less than one in one million.

Hazard indices for the accident scenario in which a worker was directly sprayed exceed one for dimethoate. Estimated cancer risks are all less than one in one million.

4.6.2.3 Prescribed Fire

Potential impacts on human health from prescribed burning as a vegetation control measure were evaluated in the *Final EIS for Vegetation Management in 13 Western States* (BLM 1991). Possible effects are summarized as follows:

Risks from Fire

Prescribed burning presents various hazards to ground crews, who could possibly receive injuries ranging from minor burns to severe burns that may result in permanent tissue damage. However, standard safety procedures, protective gear, and training are integrated into every prescribed burn plan and are expected to reduce or eliminate most hazards. If a burn escapes and causes a wildfire, members of the public in adjacent areas may be endangered, and the potential is higher for severe worker injuries (both for orchard workers and firefighters responding to the incident).

Risks from Smoke

Substances that may be found in wood smoke include particulate matter, carbon dioxide, nitrogen oxides, aldehydes, and ketones. The proportion of each varies widely, depending on factors such as moisture content in the vegetation and the temperature of the fire.

Particulate matter is a result of incomplete fuel combustion. Fine particulate matter, with a diameter less than 2.5 μm, has a greater ability than do larger particles to

avoid the body's defense mechanisms and reach the lungs. Carbon dioxide, nitrogen oxides, and other gaseous compounds of smoke generally decompose or diffuse into the atmosphere relatively quickly. However, some may attach to particulate matter and remain more concentrated and protected from decomposition. For example, aldehydes, which inhibit the removal of foreign material from the respiratory tract, may be adsorbed onto the surface of particles. Polynuclear aromatic hydrocarbons (PAHs) are of significant toxicological concern in evaluating the health effects of wood smoke. The PAHs in wood smoke contain at least five carcinogenic chemicals: benzo(a)pyrene, benzo(c)phenanthrene, perylene, benzo(g,h,i)perylene, and the benzofluoranthenes.

Exposures to the carcinogenic and possibly carcinogenic PAHs in wood smoke from burning vegetation were estimated for exposures to prescribed burns by BLM (1991). Estimated cancer risks were not expected to exceed the benchmark of 1 in 1 million for any member of the public or worker, even in extreme cases. Because smoke from prescribed fires would affect local air quality for a short time, sensitive individuals may experience eye, throat, or lung irritation from these exposures. Possible effects on workers with closer exposure may include eye irritation, coughing, and shortness of breath.

The effects (if any) on an individual from a prescribed fire or pile burn can vary greatly, and would depend on the size of the burn, the atmospheric conditions at the time of the burn, and the proximity of the individual.

4.6.2.4 Cultural Controls

Cultural controls include manual and mechanical methods of vegetation control, involving manual labor, and the use of hand tools and machinery. Examples of hand tools include hoes, rakes, and various types of pruners and cutters. Machinery includes tractors, mowers, chainsaws, gasoline-powered string trimmers, and other equipment. Impacts on safety and health could include falls, sprains, and other accidental injuries; cuts caused by tools; injuries from accidental contact with equipment or its attachments (blades, mowers, plows); and the possible initiation or aggravation of chronic health problems such as tendon or ligament damage or arthritis. There is some risk to workers of falling or being hit by limbs or tree trunks when pruning orchard trees. When temperatures are high, workers may experience fatigue, heat exhaustion, or heat stroke. Individuals who are sensitive to irritants present in some materials (sawdust, mulch, irritating plant hairs, and spines), or who are severely allergic to insect bites or stings, may experience moderate to severe health effects if exposed to these irritants in the course of conducting cultural pest management activities. No risks to members of the public are expected from cultural control methods.

4.6.2.5 Other Control Methods

No risks to human health are expected from the use of pheromone bait traps or from potential public exposure to nitrates following fertilizer use, as modeled in the risk assessment (see Chapter 4.0 of the risk assessment report).

No risks to human health were predicted as a result of potential groundwater or surface water contamination in the case of an accidental spill of fertilizer at the mixing area at either Provolt or Sprague.

4.6.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B was designed in response to the results of the quantitative risk assessments, by incorporating limitations to specifically address any non-accident risks under

Alternative A (which are summarized in Table 4.6-2). The risks from Alternative A (from Table 4.6-2) and the corresponding limitations that address the risks (from Section 2.3.3) are correlated in Table 4.6-3. With these risk-responsive limitations as part of Alternative B, no adverse effects to human health are expected from the use of chemical pesticides under this alternative, except if an accident were to occur. The risks from accidents are the same as those identified under Alternative A. Risks from biological, prescribed fire, cultural methods, and other methods of pest control are the same as under Alternative A.

Table 4.6-3. Risk-Responsive Limitations to Protect Human Health Under Alternative B

Identified Risk from Alternative A			Alternative B Limitation that Addresses Risk
Chemical	Scenario	Individual	
Chlorpyrifos	High-pressure hydraulic sprayer	Irrigation system maintenance worker	Irrigation system maintenance personnel would not work in an orchard unit treated with chlorpyrifos at the maximum label application of 2 lb a.i. per acre (estimated 0.04 lb a.i. per tree) until at least 12 days post-application.
Diazinon	High-pressure hydraulic sprayer	Mixer/loader/ applicator	An individual worker would not mix, load, and apply more than 3.75 lb a.i. of diazinon using a high-pressure hydraulic sprayer in any one day.
		Irrigation system maintenance worker	Irrigation system maintenance personnel would not work in an orchard unit treated with diazinon at the maximum label application of 0.075 lb a.i. per tree until at least 26 days post-application.
	Hydraulic sprayer with hand-held wand	Mixer/loader/ applicator	An individual worker would not mix, load, and apply more than 9 lb a.i. of diazinon using a hydraulic sprayer with a hand-held wand in any one day.
Dimethoate	Hydraulic sprayer with hand-held wand	Mixer/loader/ applicator	A closed mixing system would be used to prepare dimethoate for application by hydraulic sprayer with hand-held wand.
	Backpack sprayer	Mixer/loader/ applicator	Dimethoate would not be applied using a backpack sprayer.
Permethrin	Backpack sprayer	Mixer/loader/ applicator	No more than 0.3 lb a.i. of permethrin would be applied by any individual worker using a backpack sprayer in one day.
Propargite	Backpack sprayer	Mixer/loader/ applicator	No more than 0.7 lb a.i. of propargite would be applied by any individual worker using a backpack sprayer in one day.
Dicamba	Backpack sprayer	Mixer/loader/ applicator	No more than 0.61 lb a.i. of dicamba would be applied by any individual worker using a backpack sprayer in one day.
Hexazinone	Backpack sprayer	Mixer/loader/ applicator	No more than 6.7 lb a.i. hexazinone would be applied by any individual worker using a backpack sprayer in one day.

4.6.4 Potential Impacts of Alternative C—Non-Pesticide Pest Management

Under Alternative C, the chance of injury would exist for workers from prescribed fire and cultural control methods. There would be no risks from pesticides since they would not be used. No risks to human health are predicted from the proposed fertilizer applications.

4.6.5 Potential Impacts of Alternative D—No Action: Continue Current Management Approach

If BLM continued its current management approach, overall health risks would be intermediate between those of Alternative A and Alternative C. Pesticides would likely be used less frequently, due to the need to conduct individual NEPA analyses for each project. Therefore, the potential for risks from pesticides, including accidents, would be lower. There would be a risk of injury to workers from prescribed fire and cultural control methods.

4.7 Biological Resources

Risks to non-target species from biological, cultural, and prescribed fire methods were evaluated qualitatively. No impacts are expected from these pest control methods under any alternative.

A quantitative non-target species risk assessment evaluated the potential effects to terrestrial wildlife and aquatic species from using chemical pesticides and fertilizers under Alternative A. In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides and fertilizers proposed for use under typical conditions of use, with the possible exception of impacts to bird, reptile, amphibian, and subterranean mammal species from applications of two of the insecticides (chlorpyrifos and dimethoate at Provolt, dimethoate only at Sprague). Most of the estimated wildlife exposures are extremely low, and are several orders of magnitude below the levels of concern. No lethal risks to aquatic species were predicted for typical or maximum applications of pesticides or fertilizers under Alternative A at Provolt. At Sprague, in the case of maximum scenario runoff conditions (saturated soils plus a large storm), there is a potential risk of lethal effects from fertilizers to special status aquatic species in the main tributary to Jump-off Joe Creek. No vertebrate fish are present in onsite streams at Sprague, nor in the irrigation ditches onsite at Provolt. An analysis of the potential for sublethal effects on special status fish species identified low potential risks from pesticides and fertilizers for species near Provolt under both typical and maximum application assumptions. Special status species near Sprague could have risks of sublethal effects due to ammonia toxicity from fertilizers under maximum scenario runoff conditions.

In response to the risks identified for Alternative A, Alternative B was designed, which incorporates limitations on chemical pesticide use that reduce these estimated risks to negligible levels. Alternative C does not include the use of pesticides, and Alternative D would result in less frequent pesticide application. Therefore, negligible risks from pesticides are expected from Alternatives B and C, while risks from Alternative D would continue to be identified and evaluated on a project-by-project basis.

Under Alternatives A, B, and D, an accidental chemical spill could result in surface water concentrations that would be harmful to both terrestrial wildlife and aquatic species.

4.7.1 Analysis Approach and Assumptions

Risks from biological, prescribed fire, and cultural methods of pest control were evaluated qualitatively, based on the types of impacts possible.

4.7.1.1 Non-Target Species Risk Assessment

A quantitative non-target species risk assessment was conducted to evaluate the potential effects of the proposed chemical pesticides and fertilizers on terrestrial and aquatic wildlife species. The methodology is summarized briefly in the following paragraphs; detailed information on inputs and methodology can be found in Sections 7.0, 8.0, and 9.0 of the risk assessment reports. Additional analysis was conducted for impacts to special status aquatic species that may be present at or near Provolt and Sprague; this is described in detail in Appendix D.

The non-target species risk assessment follows the steps of problem formulation, analysis, and risk characterization, as described in EPA's Guidelines for Ecological Risk Assessment (EPA 1998b). This risk assessment also identifies uncertainties that are associated with the conclusions of the risk characterization. Risks to non-target species were evaluated for the pesticides, fertilizers, and List 1 or 2 "other" ingredients in the pesticide formulations.[3] A conceptual model was developed to illustrate the relationships between stressors (pesticides or fertilizers), exposure routes, and receptors. The conceptual model is presented in Figure 4.7-1.

The representative species evaluated in the risk assessment are listed below.

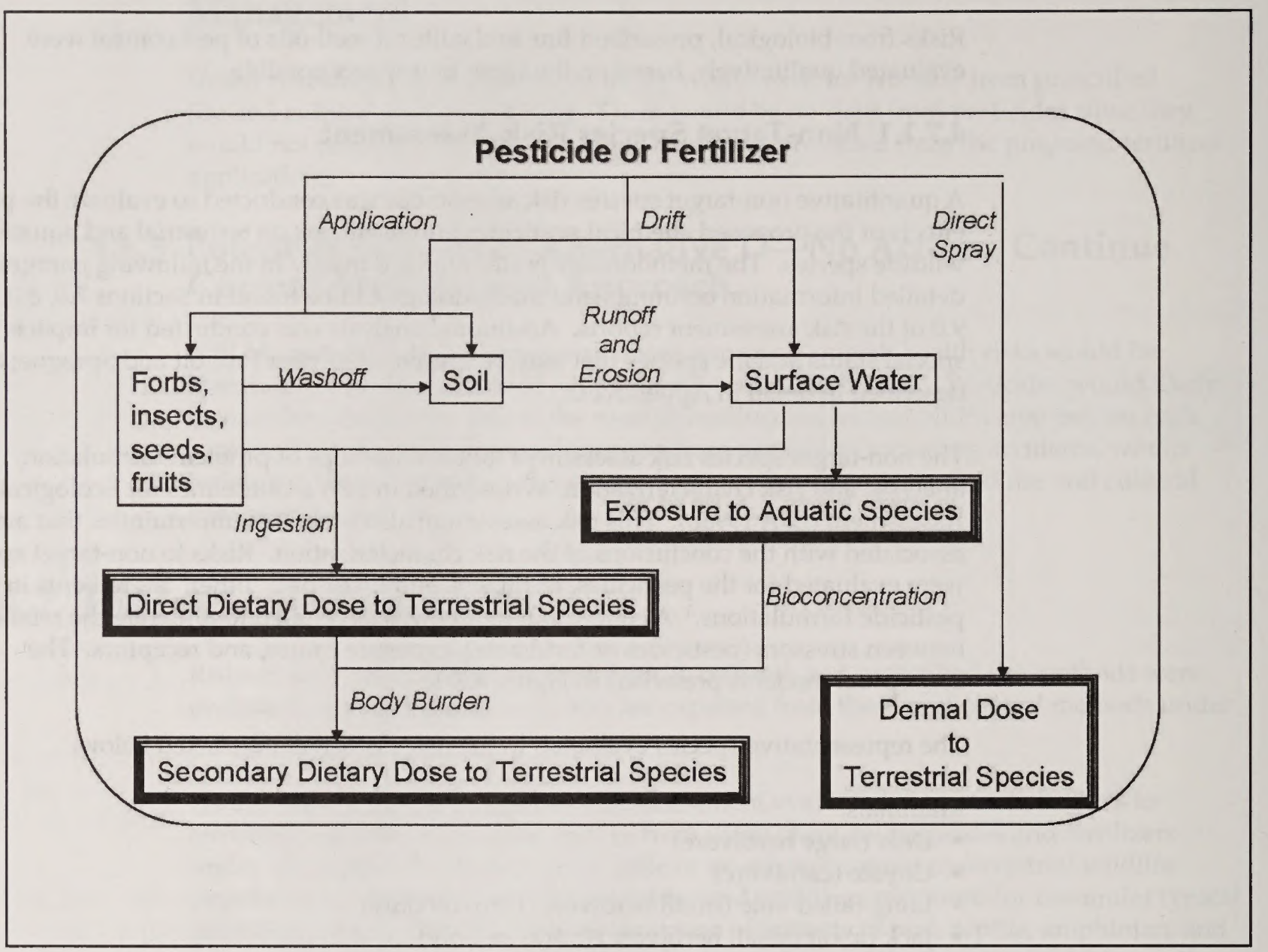
Mammals:
- Deer (large herbivore)
- Coyote (carnivore)
- Long-tailed vole (small herbivore) (Provolt only)
- Jack rabbit (small herbivore) (Sprague only)
- Pocket gopher (subterranean herbivore)
- Raccoon (omnivore)
- Long-eared myotis (insectivore)
- Dog (domestic)

Birds:
- Black-capped chickadee (conifer seed-eater)
- Western bluebird (insectivore)
- Tree swallow (insect- and fruit-eater)
- Canada goose (herbivore)
- Mallard duck (water fowl)
- Great blue heron (Provolt only)
- Common barn owl (raptor) (Provolt only)
- Red-tailed hawk (raptor) (Sprague only)
- Osprey (piscivore) (Provolt only)
- Song sparrow (seed-eater)

Reptiles/amphibians:
- Pacific chorus frog
- Western pond turtle (Provolt only)
- Gopher snake
- Western fence lizard

[3] The risk assessment evaluated the formulations that are expected to be used. It is possible that other formulations of the same active ingredients may be substituted at times. The risks from other formulations containing the same active ingredients would be similar to the risks predicted in the risk assessment.

Figure 4.7-1. Conceptual Model



These particular wildlife species were selected because they represent the majority of the species present, or the respective seed orchard has suitable habitat and is within their range (e.g., selection of black-capped chickadee as conifer seed-eater), and because they represent several types of coverage: a range of phylogenetic classes, body sizes, foraging habitat, and diets for which parameters are generally available. In addition, several special status terrestrial species were evaluated for potential risk:

- Bald eagles, a Federally listed threatened species, may hunt at Provolt Seed Orchard or occasionally pass through Sprague Seed Orchard.
- Vagrant northern spotted owls may also occasionally pass through or use Sprague or Provolt for roosting during dispersal.
- The common kingsnake is a state-listed species known to occur at Provolt.
- BLM sensitive species that could pass through Provolt or Sprague include the great gray owl and northern goshawk.
- The western pond turtle is a state-listed species that is found at both Provolt and Sprague.

Risks were estimated for aquatic species for which ecotoxicity data are available: rainbow trout as a representative coldwater fish species, the water flea *Daphnia magna* as a representative aquatic invertebrate, and tadpoles of the Pacific chorus frog as a representative amphibian aquatic stage. In addition, five special status species known to be present in the watersheds were evaluated:

- Coho salmon is a Federally listed threatened and state-listed critical species.
- Steelhead and Pacific lamprey are state-listed vulnerable species.
- Chinook salmon and cutthroat trout are a state-listed critical species.

Stressor-response profiles were prepared for each pesticide, other ingredient, and fertilizer proposed for use at the seed orchards. These profiles addressed ecotoxicity to both terrestrial and aquatic species, with the goal of identifying endpoints relevant to the types of exposure and methodology used in the assessment. The focus of this research was to identify the following toxicity endpoints:

- Median lethal dose (LD_{50})—the amount of a substance that will kill 50% of a group of laboratory animals after one dose. It is usually expressed in milligrams of the chemical per kilogram of body weight (mg/kg).
- Median lethal concentration (LC_{50})—the concentration in water of a substance that will kill 50% of the test animals (aquatic species) after they are exposed for a specified amount of time, often 24, 48, or 96 hours. It is usually expressed in milligrams of chemical per liter of water (mg/L).
- Maximum acceptable toxicant concentration (MATC)—the geometric mean of the no-observed-effect concentration and the lowest-observed-effect concentration, representing a concentration in water that is expected to be tolerated by the test species.

The stressor-response profiles for all chemicals are presented in Section 8.3 of the risk assessment reports.

Exposures to non-target species were modeled for both typical and maximum scenarios, as in the human health risk analysis summarized in Section 4.6. The results of computerized fate and transport modeling were used to estimate concentrations of chemicals at points of exposure for non-target species, and are included in Tables C-1 to C-6 in Appendix C. Details of the methods and models can be found in Sections 3.0 and 8.0 of the risk assessment reports.

The risk assessment principle that "the dose makes the poison," discussed in Section 4.6.1 under "Human Health Risk Characterization," also applies to risk characterization for wildlife and aquatic species. Both chemical-specific toxicity and estimated levels of exposure must be considered before risk can be predicted.

By comparing the exposure profile data (estimated dose or water concentration) to the stressor-response profile data (LD_{50}s, LC_{50}s, MATCs), an estimate of the possibility of adverse effects can be made. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs. The quotient is the ratio of the exposure level to the hazard level. For acute exposures, the levels of concern at which a quotient is concluded to reflect risk to non-target species are as follows:

- Terrestrial species (general): 0.5, where dose equals one-half the LD_{50}.

- Terrestrial species (special status): 0.1, where dose equals one-tenth the LD_{50}.
- Aquatic species (general): 0.5, where water concentration equals one-half the LC_{50}.
- Aquatic species (special status): 0.05, where water concentration equals one-twentieth the LC_{50}.

Due to the high level of concern for protecting threatened salmonids in the watersheds, the predicted water concentrations are also compared to the MATC for a chemical, if available.

Analysis of Risks from B.t., Imidacloprid, and Safer® Soap

These three products were added to the proposed IPM program after the quantitative risk assessment was completed, and therefore have been evaluated separately from the other proposed pesticides. The potential for non-target species impacts from these pesticides is described in Section 4.7.2.2 and 4.7.2.3 for terrestrial and aquatic species, respectively.

Adjuvants and Surfactants

In some cases, surfactants or adjuvants may be added to formulated pesticide products to improve their effectiveness or minimize handling and application problems. The seed orchards will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000b). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical would be evaluated before a use determination is made.

4.7.1.2 Risk Analysis for Sublethal Effects to Special Status Aquatic Species

The non-target species risk assessments (summarized in Appendix C) evaluated the potential for effects on fish from pesticides or fertilizers in surface runoff or from drift during application. For each chemical, the risk assessment identified the LC_{50} for the most sensitive coldwater species for which data were available. Risks were estimated for all aquatic species using this approach. However, additional analysis was determined to be necessary for special status species, since chemical exposures may adversely affect vulnerable populations by impacts other than the death of individuals, such as by interfering with migration or reproduction. These are termed "sublethal effects." This analysis is presented in detail in Appendix D, and summarized in the following paragraphs.

Along with impacts to general aquatic species, risks to five special status species known to be present in the Williams Creek watershed and Applegate River sub-basin in which Provolt is located, and in the Jump-off Joe Creek watershed where Sprague is located—coho and chinook salmon, cutthroat and steelhead trout, and Pacific lamprey—were estimated in the non-target species risk assessment.

The sublethal effects evaluated in this risk analysis for special status aquatic species are those that are relevant to biological requirements of the animal: in this case, rearing and migratory effects, and reproductive endpoints (NOAA 2002). Survival is also included in this analysis.

The assessment endpoints used to characterize potential effects reflect measures of the animal's health that can be functionally related to survival, rearing and migratory behavior, or reproductive success (NOAA 2002). Since relatively few scientific studies have examined sublethal effects of pesticides on fish physiology or behavior, the

selection of assessment endpoints is limited. In the absence of data specific to the identified species of concern, data from biologically and genetically similar surrogate species were used. Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity (within an order of magnitude) to other species tested under the same conditions. Dwyer et al. (1995) and Beyers et al. (1994), among others, have shown that endangered and threatened fish tested to date are similarly sensitive to a variety of pesticides and other chemicals as their non-endangered counterparts. Very few studies have investigated the effects of pesticides specific to the lamprey, so comparative toxicity with fish species from available literature is made cautiously. In some cases, in the absence of sublethal effects data on a specific chemical for appropriate fish species, information was evaluated for pesticides which are chemically similar and share a common mechanism of toxicity.

For the purpose of broadening and strengthening the best available science for this evaluation, the proposed-use chemicals were analyzed by chemical groups. The insecticides and acaricides are divided by chemical classes (biologicals, organophosphates, organosulfites, and pyrethroids), reflecting a common mechanism of toxicity for each class. The herbicides, fungicides, other ("inert") ingredients, fertilizers, and "other pesticides" (not inclusive within any other group classification) were evaluated wholly by their respective groups. In each case, the lowest toxicity result (indicating greatest toxicity) was used in the analysis of risks, so that this categorization approach would not sacrifice a protective analysis.

Appendix D provides details of the sublethal effects literature and analysis of risk values. Table 4.7-1 summarizes the lowest (most sensitive) toxicity values identified during this process. These data points are not intended to be definitive of all possible adverse effects at all life-stages related to survival, migration, or reproduction, but are intended to be conservative, representative estimates.

Risks to special status species were determined by comparing the stream concentrations estimated in the risk assessments and the toxicity data endpoints summarized in Table 4.7-1. A concentration-effects ratio was determined, defined as the estimated chemical concentration in surface waters over the effect concentration. Risks to survival, migratory, and reproductive endpoints were predicted as follows:

- low if the concentration-effects ratio was 0.1 or below,
- moderate if the ratio was 0.1 to 1.0, and
- high if the ratio was 1.0 or greater.

For example, if the stream concentration of a given chemical is estimated to be 0.003 mg/L, and the concentration of that chemical which affects reproduction is 0.006 mg/L, then the concentration-effect ratio would be 0.5—a moderate risk to the fish.

4.7.2 Potential Impacts of Alternative A—Maximum Production IPM

4.7.2.1 Vegetation

Biological, cultural, and prescribed fire methods of pest control are not expected to present any adverse impacts to non-target vegetation.

Although the proposed herbicides would be variously toxic to any plants with which they come into contact, there should be no undesired impacts if properly applied. One tracking status plant species has been identified on-site at Provolt: California smilax, a woody vine, is found in the riparian forests along the Applegate River and Williams Creek areas at the orchard. Two special status and one tracking status plant species have

Table 4.7-1. Summary of Special Status Species Toxicity Data

Pesticide	Effect Concentration (mg/L)		
	Survival	Migration	Reproduction
Biological insecticides	75	NA	NA
Organophosphates	0.001	0.01	0.0003
Organosulfites	0.008	NA	0.028
Pyrethroids	0.000025	0.0001	0.000004
Herbicides	0.033	0.046	2.0
Fungicides	0.0049	NA	0.0065
Other pesticides	100	NA	NA
Other ingredients	0.32	0.1	8.0
Fertilizers:			
ammonia (as NH_3)	0.0074	NA	NA
nitrate (as NO_3)	2.0	NA	NA
phosphate	49	NA	NA

NA = No data available.

been identified at Sprague: Howell's caraway (tracking species), slender meadow-foam, and coral-seeded allocarya occur in many of the wetter locations at the orchard. Howell's caraway is common along the stream channels and occurs in nearly all the riparian areas at the orchard. Slender meadow-foam and coral-seeded allocarya occur along the intermittent drainage channels and other low, seasonally wet areas. Herbicide-free buffer zones would be implemented for the protection of these species. Mechanical control of nearby weeds could be accomplished by tractor mowing and hand-pulling of the plants. Broadcast applications of herbicides are only proposed for intensively managed or disturbed areas such as along roads and fences, within orchard units, or around facilities, while spot applications would be used to control weed species in less disturbed areas. Only spot hand applications of herbicides would be conducted within the riparian buffer areas. Insecticides, fungicides, and fertilizers are only proposed for use in cultivated areas (seed orchard blocks), so no direct contact with plant species in other areas is expected. No effects are expected for any listed plants.

Aquatic plants may be present in streams and ponds that receive runoff from treated areas. A literature review was conducted to identify the levels at which any of the proposed chemicals may pose a hazard to aquatic plants (see Section 9.2.4 in the risk assessment reports). For many chemicals, tests in algae were the only available data, and are expected to provide a sensitive endpoint for hazards to aquatic plants. For each chemical, the estimated water concentrations were compared to the levels of concern. None of the predicted concentrations in onsite ditches, Williams Creek, or the Applegate River at Provolt; or onsite stream segments, Jump-off Joe Creek, or its tributaries at Sprague, exceed the effects criteria equivalent to 50% of the values reported in the literature summarized in the preceding paragraphs. Therefore, no adverse effects to aquatic plants are expected under typical or maximum conditions of pesticide or fertilizer application at Provolt or Sprague.

4.7.2.2 Terrestrial Species

Risks to General Terrestrial Species

No risks to terrestrial wildlife are predicted for biological or cultural controls. Risks to wildlife from prescribed fire were evaluated in detail in BLM (1991); this evaluation is summarized below:

> Many different wildlife (vertebrate) responses to fire have been reported. Fire effects on wildlife vary with (1) animal species complex, (2) mosaic of habitat types, (3) size and shape of fire-created mosaic, (4) fire intensity, (5) fire duration, (6) fire frequency, (7) fire location, (8) fire shape, (9) fire extent, (10) season of burn, (11) rate of vegetation recovery, (12) species that recover, (13) change in vegetation structure, (14) fuels, (15) sites, and (16) soils....
>
> In general, fire affects wildlife by direct killing, alteration of immediate postfire environments, and postfire successional influences on habitat.... Direct killing of vertebrates by prescribed burning is rare.... For those species that cannot flee a burn, the most exposed habitat sites are dry exposed slopes, hollow logs with a lot of exposed wood, burrows less than five inches deep, lower branches of trees and shrubs, and poorly insulated underground/ground nesting areas.... Effects of prescribed burning on ground cover depends on fire severity: low severity fire on wet sites would remove less cover than high severity fires on dry sites. Escaped prescribed burns may accidentally destroy riparian habitats and impact aquatic resources, causing losses of wildlife through exposure, total loss of habitat, and increased sedimentation of the aquatic habitat caused by unchecked overland flow and destabilized stream channels.
>
> Fire mainly affects wildlife through habitat alteration.,. Fire may have a positive effect on wildlife habitats by creating habitat diversity, by re-creating lost or degraded habitats for indigenous species, and by allowing for the re-introduction of extirpated species when habitat degradation was significant to their [local] extinction. Immediate postfire conditions raise light penetration and temperatures on and immediately above and below soil surfaces and can reduce soil moisture... Burning of cover and destruction of trees, shrubs, and forage modify habitat structure.... The loss of small ground cover and charring of larger branches and logs (with diameters greater than 3 inches) can negatively affect small animals and birds. Early, vigorous vegetation growth immediately after a fire alters feeding and nesting behaviors.... Postfire plant and animal succession effects creating seral and climax mosaics in habitat cannot be generalized in their effects on wildlife.... Negative impacts can be lessened if the period of treatment avoids the bird nesting season and other critical seasons when loss of cover would be critical to wildlife; for example, during critical reproductive periods and prior to severe winter weather conditions.

Because the seed orchards are intensively managed sites, and only limited areas would potentially be treated with prescribed burning, negligible impacts to wildlife are expected from vegetation control using prescribed fire.

Risks to terrestrial wildlife from pesticide and fertilizer use under Alternative A are summarized in Table 4.7-2.

Similar to the negligible risks to humans, minimal to no risks are predicted for nontarget mammals from the biological insecticide *B.t.* Avian studies demonstrated that *B.t.* was practically nontoxic to mallard ducks and bobwhite quail after five days of oral dosing at up to 2,900 mg/kg/day, indicating negligible toxicity to bird species (EPA 1998a). No impacts to terrestrial animals are expected from the use of *B.t.*

Table 4.7-2. Summary of Scenarios with Predicted Non-Target Species Risks Under Alternative A

Chemical	Scenario	Species	Risk*
Risks to General Terrestrial Wildlife			
Chlorpyrifos	High-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand	Black-capped chickadee	Q = 0.551 (typical) (Provolt only) and 2.28 (maximum)
Diazinon	High-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand	Black-capped chickadee	Q = 7.52 (maximum)
		Western bluebird	Q = 1.08 (maximum)
		Song sparrow	Q = 0.503 (maximum)
Dimethoate	Hydraulic sprayer with hand-held wand, backpack sprayer	Pocket gopher	Provolt: Q = 0.720 (typical) and 4.14 (maximum) Sprague: Q = 0.743 (typical) and 4.28 (maximum)
		Black-capped chickadee	Q = 10.4 (typical) and 73.3 (maximum) (Provolt) and 74.1 (maximum) (Sprague)
		Western bluebird	Provolt: Q = 2.20 (typical) and 25.3 (maximum) Sprague: Q = 2.27 (typical) and 26.1 (maximum)
		Song sparrow	Provolt: Q = 2.39 (typical) and 28.1 (maximum) Sprague: Q = 2.47 (typical) and 29.0 (maximum)
		Pacific chorus frog	Provolt: Q = 15.6 (typical) and 88.1 (maximum) Sprague: Q = 16.1 (typical) and 90.9 (maximum)
		Long-tailed vole	Q = 0.840 (maximum) (Provolt only)
		Long-eared myotis	Q = 0.827 (maximum) (Provolt) Q = 0.854 (maximum) (Sprague)
		Mallard duck	Q = 0.553 (maximum) (Provolt) Q = 0.571 (maximum) (Sprague)
		Great blue heron	Q = 3.26 (maximum) (Provolt only)

Table 4.7-2. Summary of Scenarios with Predicted Non-Target Species Risks Under Alternative A (continued)

Chemical	Scenario	Species	Risk*
Dimethoate (continued)	Hydraulic sprayer with hand-held wand, backpack sprayer	Red-tailed hawk	Q = 4.23 (maximum) (Sprague only)
		Tree swallow	Q = 15.6 (maximum) (Provolt) Q = 16.1 (maximum) (Sprague)
		Canada goose	Q = 2.34 (maximum) (Provolt) Q = 2.41 (maximum) (Sprague)
		Gopher snake	Q = 12.1 (maximum) (Provolt) Q = 12.5 (maximum) (Sprague)
		Western fence lizard	Q = 1.53 (maximum) (Provolt) Q = 1.58 (maximum) (Sprague)
Risks to Special Status Terrestrial Species			
Chlorpyrifos	Hydraulic sprayer with hand-held wand, backpack sprayer	Western pond turtle	Q = 0.125 (typical) (Provolt only) and 0.502 (maximum)
		Common kingsnake	Q = 0.490 (maximum) (Provolt only)
Diazinon	Hydraulic sprayer with hand-held wand, backpack sprayer	Western pond turtle	Q = 1.65 (maximum)
		Common kingsnake	Q = 1.65 (maximum) (Provolt only)
Dimethoate	Hydraulic sprayer with hand-held wand, backpack sprayer	Western pond turtle	Provolt: Q = 4.09 (typical) and 21.8 (maximum) Sprague: Q = 4.23 (typical) and 22.5 (maximum)
		Common kingsnake (Provolt only)	Q = 0.814 (typical) and 118 (maximum)
		Spotted owl	Q = 5.00 (maximum) (Provolt) Q = 5.16 (maximum) (Sprague)
		Bald eagle	Q = 2.69 (maximum)
		Northern goshawk	Q = 4.45 (maximum)
		Great gray owl	Q = 4.27 (maximum)
Risks to General Aquatic Wildlife			
None.	None.	None.	None.
Risks to Special Status Aquatic Species			
Fertilizer	General fertilization (Sprague only)	Coho salmon in main tributary to Jump-off Joe Creek	Q = 0.808 (maximum)
		Chinook salmon in main tributary to Jump-off Joe Creek	Q = 0.808 (maximum)
		Cutthroat trout in main tributary to Jump-off Joe Creek	Q = 0.808 (maximum)
		Steelhead in main tributary to Jump-off Joe Creek	Q = 0.808 (maximum)
		Pacific lamprey in main tributary to Jump-off Joe Creek	Q = 0.808 (maximum)

*Risks are predicted for general terrestrial species if Q > 0.5; for special status terrestrial species if Q > 0.1; for general aquatic species if Q > 0.5, and for special status aquatic species if Q > 0.05.

The insecticide imidacloprid, which was not previously analyzed, is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. No exposure to terrestrial species would occur. In terms of risks to mammalian wildlife, it is also instructive to note that the active ingredient imidacloprid is the same as that found in the Advantage® dog and cat flea control products, which are applied directly to the skin of animals at a recommended dose rate and frequency of 10 mg/kg body weight once per month.

Little to no terrestrial species risk from seed orchard use of Safer® Insecticidal Soap is indicated by the active ingredient's short half-life (less than one day), natural occurrence of the degradation products (fatty acids), and low toxicity (oral LD_{50} of 74,000 mg/kg for the fatty acid oleic acid, and five-day $LC_{50} > 5{,}000$ ppm in food for mallard ducks and bobwhite quail) (EPA 1992).

At Provolt, risks are predicted from chlorpyrifos for the black-capped chickadee in the typical and maximum scenarios. Risks are predicted from diazinon for the black-capped chickadee, western bluebird, and song sparrow in the maximum scenario. Dimethoate was estimated to present risks to the pocket gopher, black-capped chickadee, western bluebird, song sparrow, and Pacific chorus frog in the typical scenario, and to these same species plus the long-tailed vole, long-eared myotis, mallard duck, great blue heron, tree swallow, Canada goose, gopher snake, and western fence lizard in the maximum scenario.

At Sprague, risks are predicted from chlorpyrifos for the black-capped chickadee in the maximum scenario. Risks are predicted from diazinon for the black-capped chickadee, western bluebird, and song sparrow in the maximum scenario. Dimethoate was estimated to present risks to the pocket gopher, black-capped chickadee, western bluebird, song sparrow, and Pacific chorus frog in the typical scenario, and to these same species plus the long-eared myotis, mallard duck, red-tailed hawk, tree swallow, Canada goose, gopher snake, and western fence lizard in the maximum scenario.

In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides and fertilizers proposed for use at the seed orchards under typical conditions of use, with the possible exception of impacts to bird, reptile, amphibian, and subterranean mammal species from applications of two of the insecticides (chlorpyrifos and dimethoate) at Provolt and one of the insecticides (dimethoate) at Sprague. Most of the estimated doses are extremely low, with risk quotients several orders of magnitude below the levels of concern. A margin for error is provided by the methodology applied, which uses reasonable assumptions that tend toward overstating potential exposures to wildlife, in the absence of site-specific data on potential exposure patterns. In addition, the chemicals have relatively short half-lives and are not expected to remain in the environment for significant periods of time: two herbicides (hexazinone and picloram) have soil half-lives in the five to six month range, while the rest of the pesticides' soil and foliar half-lives are less than three months.

Although some terrestrial insects onsite may be affected by the insecticide applications, and may constitute a portion of the dose to insectivorous species, populations of beneficial insects as a whole are not expected to suffer adverse impacts because the proposed seed orchard applications are localized. Although honeybees and other pollinators are generally susceptible to insecticides, including the biological insecticide *B.t.*, the protection measures that are part of all the alternatives include practices to minimize potential exposures; see Section 2.3.1.

It appears that insecticide applications may have adverse impacts on local earthworm populations (see discussion in Section 9.2.1 of the risk assessment reports). However,

any possible impacts are expected to be reversible, given that these chemicals are not persistent in the soil and that limited areas would be treated only on an as-needed basis in any growing season, allowing for re-population from adjacent untreated areas.

Risks to Special Status Terrestrial Species

At Provolt, risks are predicted from chlorpyrifos for the western pond turtle in the typical and maximum scenarios, and for the common kingsnake in the maximum scenario. Risks are predicted from diazinon for the western pond turtle and common kingsnake in the maximum scenario. Dimethoate was estimated to present risks to the western pond turtle and common kingsnake in the typical scenario, and to these same species plus the spotted owl and bald eagle in the maximum scenario. Although not quantified in the risk assessment, risks from dimethoate would also be predicted for the northern goshawk and great gray owl in the maximum scenario, based on the conclusions for similar applications in the Sprague Seed Orchard risk assessment.

At Sprague, chlorpyrifos and diazinon were predicted to pose risks to the western pond turtle in the maximum scenario. Dimethoate is associated with risk for the western pond turtle in the typical scenario, and risk to the western pond turtle, spotted owl, great gray owl, and northern goshawk in the maximum scenario. Although not quantified in the risk assessment, risks from dimethoate would also be predicted for the bald eagle in the maximum scenario, based on the conclusions for similar applications in the Provolt Seed Orchard risk assessment. With the exception of risks to reptiles from dimethoate, typical conditions of application using the proposed pesticides and fertilizers are not expected to present risks to special status terrestrial species.

Risks from Accidents

Risks are predicted for all terrestrial species except the deer, coyote, raccoon, and dog in the accident scenario in which an animal ingests an acephate implant capsule.

4.7.2.3 Aquatic Species

Since biological, cultural, and prescribed fire methods are expected to have no significant impacts to surface water (as discussed in Section 4.4.2.2), no impacts to aquatic species would occur from the use of those methods.

Risks to General Aquatic Species

At Provolt, no risks were predicted for any aquatic invertebrates or tadpoles in the onsite irrigation ditches; nor for any coldwater fish species (represented by rainbow trout) in Williams Creek; nor for any coldwater fish, aquatic invertebrates, or tadpoles in the Applegate River from any pesticides or fertilizers proposed for use at Provolt.

At Sprague, no risks were predicted from any pesticides or fertilizers for any aquatic invertebrates or tadpoles in the onsite drainages; nor for any coldwater fish species (represented by rainbow trout) in Jump-off Joe Creek or its tributaries. No vertebrate fish are present in onsite streams at Sprague.

Laboratory toxicity studies and field observations indicate that *B.t.* would not have any adverse effect on fish species (EPA 1998a). However, moderate toxicity to the water flea *Daphnia magna* (EPA 1998a) indicates that some impacts to aquatic invertebrates could be possible if the biological insecticide entered surface water. Such impacts would be expected to be localized and temporary, since the bacterium does not proliferate in aquatic habitats. Buffer zones and other standard protection measures (see Chapter 2) would minimize the potential for any surface water contamination.

The insecticide imidacloprid, which was not previously analyzed, is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. Movement of imidacloprid is restricted to the vascular system of the tree. The potential for imidacloprid to enter air, soil, or water is negligible when using Imicide® capsules. Although imidacloprid residues have been found in leaves and needles following Imicide® application, vegetation buffers, which are a minimum of 40 feet between potentially treated trees and live water, would be expected to intercept needles or leaves that may fall from treated trees. (Observation of fallen needles within orchard units indicates that needles generally fall close to the drip line of trees and are held within the dense grass cover crop once they become wet.) With a 96-hour LC_{50} of 211 mg/L reported for rainbow trout and a 48-hour LC_{50} of 85 mg/L reported for the water flea *Daphnia magna*, toxicity to aquatic species is expected to be low (Extoxnet 2003). Therefore, in the unlikely process by which any residues could be moved by needle drop → weathering → runoff → downstream transport, the resulting concentrations would be expected to be many orders of magnitude below those associated with any type of effect on aquatic species.

Soap salts such as potassium salts of fatty acids, the active ingredient in Safer® Insecticidal Soap, are only slightly toxic to fish, but are highly toxic to aquatic invertebrates (EPA 1992). However, they are not applied directly to water in the the proposed seed orchard IPM program, nor in any other labeled uses of this product. Their quick (less than one day) degradation and low-impact application methods (spraying individual trees in managed orchard units) would be associated with little opportunity for transport to surface water, and thus they would pose little risk to aquatic species.

Risks to Special Status Aquatic Species

Risk of Lethal Effects

In the lethality effects evaluation contained in the risk assessments (summarized in Appendix C), no risks to special status species in Beidgepoint Ditch, Laurel Hill Ditch, Williams Creek, or the Applegate River were predicted from any pesticides or fertilizers proposed for use at Provolt. However, under maximum scenario runoff conditions at Sprague, ammonia from runoff containing fertilizers was predicted to pose a risk of lethal effects to special status fish species south of the orchard in the main tributary to Jump-off Joe Creek. No risks of lethal effects were predicted from typical conditions of fertilizer use at Sprague.

Risk of Sublethal Effects

The risk analysis of sublethal effects to special status aquatic species is presented in Appendix D and summarized in the following paragraphs.

For all of the proposed insecticides, including the biological insecticide *B.t.*, it is conceivable there could be a localized loss of part of the insect food source for fish species due to drift or runoff to streams. However, any chemical presence and associated decrease in non-target aquatic insect populations would be temporary and localized; insects would be expected to quickly re-populate from upstream areas. Therefore, no indirect effects to fish from loss of insect food sources are expected. Additionally, no adverse effects were predicted for aquatic invertebrates in the general aquatic species analysis, so no impacts to food sources for special status fish are expected.

Typical and maximum applications of *B.t.*, organophosphates, organosulfites, and pyrethroids are expected to present low risks for the sublethal effects evaluated to special status aquatic species in all surface waters at and near Provolt and Sprague.

Typical and maximum applications of all herbicides, other pesticides, and other ingredients are expected to present low risks of sublethal effects in all surface waters at Provolt and Sprague. Typical applications of fertilizers are of low risk in all surface waters. Maximum scenario application of fertilizers are of low risk at Provolt. If maximum scenario runoff conditions were present at Sprague following fertilizer application, there would be a moderate risk of ammonium toxicity to special status species that may be present in Jump-off Joe Creek and a high risk of ammonium toxicity to special status species in its main tributary.

Risks from Accidental Spills

At Provolt, aquatic invertebrates are at risk of lethal effects from a spill of chlorpyrifos concentrate at the mixing area, and special status aquatic species are at risk from a spill of esfenvalerate or permethrin concentrate. Spills of tank mix directly into streams were predicted to pose risks of lethal effects to coldwater fish (represented by rainbow trout) from chlorpyrifos; to aquatic invertebrates from chlorpyrifos, diazinon, esfenvalerate, and permethrin; and to special status species from chlorpyrifos, esfenvalerate, permethrin, chlorothalonil, and triclopyr.

At Sprague, special status species are at risk of lethal effects from a spill of esfenvalerate concentrate at the mixing area. Spills of tank mix directly into streams were predicted to pose risks of lethal effects to aquatic invertebrates and special status species from chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, and chlorothalonil.

The details of the modeled accidental spills are presented in Section 3.2.5 of the risk assessment reports.

4.7.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B was designed in response to the results of the quantitative risk assessment, by incorporating limitations to specifically address any risks from applications under Alternative A (which are summarized in Table 4.7-2). The risks from Alternative A (from Table 4.7-2) and the corresponding limitations that address the risks (from Section 2.3.3) are correlated in Table 4.7-3. With these risk-responsive limitations as an integral part of Alternative B, no adverse effects to terrestrial wildlife or to aquatic species, including special status fish species, are expected from the use of chemical pesticides under this alternative. If maximum scenario runoff conditions were present, there could be risks from fertilizer to special status fish species of lethal effects in the main tributary to Jump-off Joe Creek at Sprague, and sublethal effects in both Jump-off Joe Creek and its main tributary.

BLM's Biological Assessments concluded the following:

- At Provolt, it is unlikely that surface waters utilized by southern Oregon/northern California coasts coho salmon would be contaminated at levels high enough to result in either lethal or sublethal effects. Given the low risk identified for coho salmon under the maximum production alternative, and the inclusion of the additional application limitation in the proposed action, the proposed action may affect, but is not likely to adversely affect, southern Oregon/northern California coasts coho salmon or their designated critical habitat.

- At Sprague, it is unlikely that the proposed action would result in chemical concentrations in surface waters used by southern Oregon/northern California coasts coho salmon at levels high enough to result in either lethal or sublethal effects. Given the negligible risks predicted from pesticide applications under typical or maximum

Table 4.7-3. Risk-Responsive Limitations to Protect Ecological Resources Under Alternative B

Identified Risk from Alternative A			Alternative B Limitation that Addresses Risk
Chemical	Scenario	Species	
Chlorpyrifos	High-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand, backpack sprayer	Conifer-seed-eating birds, Western pond turtle	Would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit when a high-pressure hydraulic sprayer is used, or within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or unit edge when applied with a hydraulic sprayer with hand-held wand (these are the distances associated with no drift from the respective application methods). It would not be applied to more than 166 trees at a rate of 0.02 lb a.i. per tree (nor any combination of number of trees and application rate that is more than 3.32 lb a.i. total applied) in any 12-acre area within a 14-day period.
Diazinon	High-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand, backpack sprayer	Seed-eating birds, insect-eating birds, western pond turtle	Would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit when a high-pressure hydraulic sprayer is used, or within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or unit edge when applied with a hydraulic sprayer with hand-held wand (these are the distances associated with no drift from the respective application methods). It would not be applied to more than one tree per acre within an 11-day period.
Dimethoate	Hydraulic sprayer with hand-held wand, backpack sprayer	Seed-eating birds; insect-, fruit-, and vegetation-eating birds; water fowl; raptors; small and subterranean herbivores; insect-eating mammals; amphibians; reptiles; western pond turtle; common kingsnake; spotted owl, bald eagle, northern goshawk; great gray owl	Would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than three trees at a rate of 0.13 lb a.i. per tree (nor any combination of trees and application rate that is more than 0.39 lb a.i. total applied) in any one-acre area within a seven-day period.

conditions and from fertilizers under typical conditions, and the improbability that fertilizers would be applied under the maximum conditions analyzed, the proposed action may affect, but is not likely to adversely affect, southern Oregon/northern California coasts coho salmon or their designated critical habitat.

NOAA Fisheries responded with biological opinions concluding that the proposed action is not likely to jeopardize the continued existence of Southern Oregon/Northern California Coasts coho salmon; the opinions specified reasonable and prudent measures, with associated terms and conditions, to further protect the species. See Section 2.3.3 for additional details.

Should an accidental spill to surface water occur, the risks from that accident would be the same as those identified under Alternative A.

Risks from biological, prescribed fire, and cultural methods of pest control are the same as under Alternative A.

4.7.4 Potential Impacts of Alternative C—Non-Pesticide Pest Management

Under Alternative C, there would be no risks from pesticides since they would not be used. Risks from fertilizers would be the same as described under Alternative A. As discussed under Alternative A, no risks to non-target species from biological, cultural, or prescribed fire control methods would be expected from their use in an IPM program at Provolt or Sprague.

4.7.5 Potential Impacts of Alternative D—No Action: Continue Current Management Approach

If BLM continued its current management approach, risks would be intermediate between Alternative A and Alternative C. Pesticides would likely be used less frequently, due to the need to conduct individual NEPA analyses for each project. Therefore, the potential for risks from pesticides, including accidents, would be lower. Risks from biological, prescribed fire, and cultural methods of pest control would be higher than under Alternatives A or B, due to their increased use compared to those alternatives. Risks from fertilizers would be the same as under Alternative A.

4.8 Noise

The proposed action or an alternative could produce occasional short-term impacts on the noise environment, but the impacts would not be significant. Equipment noise associated with any pest management alternative would not significantly influence the noise environment, because the noise generated would be intermittent and would occur during daytime hours, would be attenuated by the equipment's distance from noise receptors, and would be indistinguishable from the use of the same or similar equipment for non-pest management activities. Under the no action alternative, noise levels would be unchanged.

4.8.1 Analysis Approach and Assumptions

The analysis of noise impacts involved assessing the estimated noise levels from the proposed action and alternatives, comparing them with ambient noise levels, and identifying the presence of any sensitive receptors near the seed orchard. Vicinity maps of Provolt and Sprague were used to determine the locations of possible sensitive receptors.

Noise perception and annoyance to the public depend on the intensity of the sound (measured in dB), the frequency of the sound (high or low pitch), and the duration of the noise (steady, intermittent, or impulsive (sudden)). For single noise events, an increase of 3 dB is perceived by most people as barely louder. An increase of 6 dB is perceived as noticeably louder, and an increase of 10 dB is perceived as twice as loud (Cavanaugh 1998).

There are two basic considerations for protecting the community from increased noise from short-term sources. To protect human health, noise levels must not exceed limits identified with potential loss of hearing. An L_{eq} of 73 dB sustained over 8 hours for 250

days or more per year can cause hearing loss to a general population over a prolonged time period (about 40 years) (EPA 1974). The other consideration for protecting the public is noise interference with activity, or annoyance. This depends upon the setting in which the increased noise takes place, for both indoor and outdoor activities. Thresholds for various uses vary from 45 L_{eq} (averaged over 24 hours) within residences and other locations based on a quiet use, to 70 L_{eq} (averaged over 24 hours) for outdoor exposure in recreational areas (EPA 1974). Communities that typically experience higher noise levels tolerate higher increases in noise (typically 5 dB more without complaints).

The impact on the noise environment is related to the magnitude of the noise levels and the proximity of noise-sensitive receptors to the noise source. Increasing the L_{eq} (averaged over 24 hours) to 73 dB or above for one year or more could be a significant impact, as this could potentially cause hearing loss in a portion of the general public. If noise levels increased, but affected noise-sensitive receptors to a level below 73 L_{eq}, the impact would not be significant. A decrease in noise levels would be a beneficial impact.

4.8.2 Potential Impacts of Alternative A—Maximum Production IPM

Normal background noise levels average about 50 dBA at both Provolt and Sprague and in their surrounding areas. The IPM activities associated with Alternative A (tractors and other equipment) would negligibly increase noise levels at either seed orchard for short periods, and the type of noise impact would be similar to the current noise environment at Provolt or Sprague. As noted in Table 3.8-2, at 1,600 feet away from the noise source, composite noise would attenuate to the area's ambient noise level.

There are no sensitive receptors within 1,000 feet of either seed orchard. There would be no significant noise impacts.

4.8.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under Alternative B, impacts would be essentially the same type as under Alternative A, but could be slightly less if equipment use were reduced. Noise impacts would be insignificant.

4.8.4 Potential Impacts of Alternative C—Non-Pesticide Pest Management

Under Alternative C, no pesticides would be used, and noise impacts could be similar to or less than the impacts under Alternative B, depending on the types of mechanical control used. Noise impacts would be insignificant.

4.8.5 Potential Impacts of Alternative D—No Action: Continue Current Management Approach

Under Alternative D, the current insignificant noise impacts would continue. Before BLM applied any pesticides, an EA would be prepared to determine potential impacts of that application, and would include an assessment of potential noise impacts to the area, if appropriate.

4.9 Cultural Resources

Cultural resources are limited, nonrenewable resources whose values may easily be diminished by physical disturbances. There are no cultural resource sites located on the Provolt or Sprague Seed Orchards. The proposed action and alternatives include no construction or excavation activities that could disturb any undiscovered cultural resources either on or adjacent to the orchards. There would be no impacts to cultural resources from any alternative.

4.9.1 Analysis Approach and Assumptions

To determine potential impacts, the analysis focused on the types of activities that would occur, the location where they would occur, and the significance of the resource in that location. NEPA documents and past archaeological and historic resources surveys were reviewed. BLM and the State Historic Preservation Office (SHPO) were consulted for the latest information concerning cultural resources on the seed orchard.

The criteria used to determine the significance of impacts on cultural resources includes the effects on National Register of Historic Places (NRHP) eligibility, future research potential, or suitability for religious or traditional uses. An impact could be adverse if it resulted in the physical alteration, destruction, or loss of a resource listed or eligible for listing in the NRHP. The impact of the action could be beneficial if it protected or restored the resource.

4.9.2 Potential Impacts of All Actions

As noted in Section 3.9, no cultural resource sites have been identified at Provolt or Sprague. There are no nearby Native American religious sites. Neither the proposed action nor any alternative includes construction or excavation activities that could disturb any undiscovered cultural resources either on or adjacent to the orchard. There would be no impacts to cultural resources from any alternative.

In the unlikely event that archaeological materials were encountered during project activities, work in that location would cease until the artifacts were evaluated by a qualified archaeologist, and the BLM had consulted with the Oregon SHPO if applicable.

4.10 Socioeconomics and Environmental Justice

Socioeconomic impacts are generally related to changes in an area's population, number of jobs, employment structure, or income. No population or employment impacts are projected for the proposed action or any alternative at Provolt and Sprague. However, income in the ROI could be affected by changes in the land's productivity or value, or in the marketability of its products. There are three possible factors that would lead to economic impacts: offsite pesticide transport to neighboring land parcels, especially any used for organic production; decreased production on and adjacent to the seed orchard if pest control methods are not successful; and pest infestation on and adjacent to the seed orchard if pest control methods are not successful. The potential for impacts to adjacent parcels is negligible, with the probability for impact slightly higher under Alternative A. Decreased production is least likely under Alternative A; the probability increases slightly with Alternative B, and Alternative C has the greatest potential for this impact. Economic loss from uncontrolled pest infestation is most likely under Alternative C, and is unlikely under Alternatives A or B. Overall, socioeconomic and environmental justice impacts would be insignificant under Alternatives A, B, or C. Similarly, under Alternative D (no action), the current insignificant impacts would be unchanged.

4.10.1 Analysis Approach and Assumptions

Measures used for impact analysis include population, employment, and income. The analysis used population data from the USBC, and employment and income data from the U.S. Bureau of Economic Analysis and the Oregon Employment Department. To predict impacts to socioeconomic resources in a given ROI, significance criteria are determined by analyzing long-term fluctuation in elements such as population, employment, and income within that ROI. This approach allows an ROI-specific determination of the appropriate levels, or thresholds, beyond which changes in an element would noticeably affect individuals and communities. The analysis compares each element's actual yearly change to the predicted amount of change, which, in turn, is based on the average annual change that has occurred over the long-term period used as a basis for the analysis (1980-2000). The annual deviations between actual change and predicted (average) change are the basis for determining a threshold of significance for each element. Regions are assumed to have a greater capacity for positive change—growth—than for negative change; therefore, the negative income threshold is decreased by one-third to avoid understating impacts from actions that may result in a decline in income. Based on this methodology, a significant adverse impact for this ROI (Josephine County) would be a decline of more than 6% in projected income as a result of an action assessed in this EIS. An increase in income would be considered beneficial. Since no employment or population changes are anticipated, no significance criteria were defined for those measures.

There are no disproportionate populations of low-income or minority persons, or children, in the areas surrounding Provolt and Sprague. Therefore, no environmental justice impacts would occur under any alternative considered in this EIS.

4.10.2 Potential Impacts of Alternative A—Maximum Production IPM

Under Alternative A, the risk assessment predicted negligible contamination to neighboring land parcels (see Figure 3.5-1.) While the probability of pesticide drift contaminating adjacent parcels is extremely low, unforeseen weather conditions coupled with a failure to quickly respond to adverse conditions by ceasing the application could increase the possibility of such an impact. Economic impacts to individual parcels adjacent to Provolt or Sprague would be insignificant, and the overall economic impacts of inadvertent contamination would be insignificant to the ROI.

Economic losses due to increases in insects or disease, or to pest infestation, are very unlikely. Impacts would be insignificant.

4.10.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under the proposed action, the more controlled application procedures (see Section 2.3.3) would further reduce the risk of offsite pesticide transport to neighboring land parcels at both seed orchards. The potential economic impacts to neighboring landowners from pesticide drift would be as described under Alternative A, but the likelihood for such impacts would be reduced. Production losses due to increases in insects or disease, or to pest infestation, are very unlikely. Impacts to income would be insignificant.

4.10.4 Potential Impacts of Alternative C—Non-Pesticide Pest Management

Under Alternative C, no pesticides would be used, so there would be no possibility of pesticide transport to nearby land parcels. However, reduced production and/or pest infestation could result if non-pesticide pest control methods were not successful, resulting in economic losses. If the pest infestation were to spread from either seed orchard to neighboring land parcels whose crops were susceptible to those pests, those landowners would also suffer an economic loss. Although there could be localized economic losses, the overall impact to the ROI would be insignificant.

4.10.5 Potential Impacts of Alternative D—No Action: Continue Current Management Approach

Under Alternative D, the current insignificant economic impacts would continue. Before BLM undertook a pesticide application, an EA would be prepared to determine potential impacts of that application. The EA would include an assessment of the potential to contaminate neighboring land parcels and the consequent economic impacts.

4.11 Cumulative Impacts

According to CEQ regulations at 40 CFR 1508.7, "cumulative impact" is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

In terms of pesticide application, other agencies or private individuals in the vicinity of the orchard may be using other treatments with many of the same chemicals as BLM proposes to use. Also, other applications may be used in agriculture, forestry, or industrial operations that might create an overall chemical burden in the orchard area. While the chemicals used in the proposed IPM program are not expected to have an impact on water quality, streams that may receive some pesticide or fertilizer drift or runoff from the orchard also may be receiving drift or runoff of chemicals from other locations, and this cumulative burden may place the aquatic ecosystems at risk. Given the remote location of the Provolt orchard, however, and the limited water resources at Sprague, adverse cumulative effects are not anticipated.

The human health risk assessment addressed cumulative risk to members of the public and workers from all of the pesticides and fertilizers as proposed for use under Alternative A, and from the subset of pesticides that are more likely than others to be used in a given year. Since no data exist indicating synergistic toxicity among the pesticides proposed for use at Provolt and Sprague, cumulative human health risks were estimated assuming additive toxicity. No risks to members of the public were predicted from these aggregated exposures. For workers, the highest cumulative exposure could occur if one employee was involved in all pesticide applications. In this case, a risk of health effects is predicted, as the cumulative dose exceeds the acceptable level by a factor of over 1,000 for noncarcinogenic effects, and the cumulative cancer risk is 2.5 in 100,000 at Provolt (and slightly less at Sprague); these risks are greater than the generally accepted level of one in one million. It is important to note that this cumulative risk scenario includes the unlikely case in which all pesticides that target every pest problem are called for during the season. The highest contributor to the cumulative hazard index is dimethoate, and the main contributor to the cancer risk is propargite. For the subset of

pesticides more likely to be used, no cumulative risks to workers were predicted. Actual cumulative risk values are likely to be less than the results estimated in this conservative analysis for the following reasons:

- It is highly unlikely that one individual would be exposed to every chemical in all of the scenarios evaluated in the risk assessment;
- Several pesticides are proposed for use as alternatives for certain groups of target pests or weeds, and if one were selected for use in a given season, the alternatives would not also be used;
- To avoid underestimating risk, where multiple application methods are possible for a proposed pesticide treatment scenario, the method with the highest associated risk was included in the cumulative assessment; and
- The temporal spacing of the potential chemical applications would correspond to a timeline in which some exposure routes were no longer active due to dissipation and degradation, prior to application of other chemicals.

4.12 Mitigation Measures

Alternative A.

Based on the results of the quantitative risk assessment, the selection of Alternative A, Maximum Production IPM, could result in environmental impacts to human health and biological resources. Therefore, CEQ's regulations for implementing NEPA require that potential mitigation measures for these consequences be identified in this EIS. The following measures have been identified to mitigate the risks predicted for Alternative A:

- An individual worker would not mix, load, and apply more than 3.75 lb a.i. of diazinon using a high-pressure hydraulic sprayer in any one day.
- An individual worker would not mix, load, and apply more than 9 lb a.i. of diazinon using a hydraulic sprayer with a hand-held wand in any one day.
- A closed mixing system would be used to prepare dimethoate for application by hydraulic sprayer with hand-held wand.
- Dimethoate would not be applied using a backpack sprayer.
- No more than 0.3 lb a.i. of permethrin would be applied by any individual worker using a backpack sprayer in one day.
- No more than 0.7 lb a.i. of propargite would be applied by any individual worker using a backpack sprayer in one day.
- No more than 0.61 lb a.i. of dicamba would be applied by any individual worker using a backpack sprayer in one day.
- No more than 6.7 lb a.i. hexazinone would be applied by any individual worker using a backpack sprayer in one day.
- Irrigation system maintenance personnel would not work in an orchard unit treated with chlorpyrifos at the maximum label application of 2 lb a.i. per acre (estimated 0.04 lb a.i. per tree) until at least 12 days post-application.

- Irrigation system maintenance personnel would not work in an orchard unit treated with diazinon at the maximum label application of 0.075 lb a.i. per tree until at least 26 days post-application.

- Chlorpyrifos would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit when a high-pressure hydraulic sprayer is used, or within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or unit edge when applied with a hydraulic sprayer with hand-held wand (these are the distances associated with no drift from the respective application methods). It would not be applied to more than 166 trees at a rate of 0.02 lb a.i. per tree (nor any combination of number of trees and application rate that is more than 3.32 lb a.i. total applied) in any 12-acre area within a 14-day period.

- Diazinon would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit when a high-pressure hydraulic sprayer is used, or within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or unit edge when applied with a hydraulic sprayer with hand-held wand (these are the distances associated with no drift from the respective application methods). It would not be applied to more than one tree per acre within an 11-day period.

- Dimethoate would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than three trees at a rate of 0.13 lb a.i. per tree (nor any combination of trees and application rate that is more than 0.39 lb a.i. total applied) in any one-acre area within a seven-day period.

Alternative B.

The design of Alternative B, IPM with Environmental Protection Emphasis, includes the limitations specified in Section 2.3.3, and is expected to address all identified potential risks, with the exception of possible maximum scenario risks from fertilizers at Sprague. These risks are only predicted for conditions in which soils are saturated and then a large storm event follows application, which is a situation with a very low probability of occurrence, representing the upper bound of the risk range estimated in the risk assessment. During the ESA consultation process, NOAA Fisheries identified additional terms and conditions to provide additional protection to threatened coho salmon. These requirements are listed in Section 2.3.3 of this Final EIS.

Alternative C.

The only significant impacts associated with Alternative C, Non-Pesticide Pest Management, are those from maximum scenario fertilization, as described in the preceding paragraph. No additional mitigation is identified for this risk.

Alternative D.

Mitigation measures for use of pesticides under Alternative D, No Action, would be identified on a project-by-project basis during the specific NEPA assessments.

The ROD that will be published at the conclusion of the EIS process will specify the mitigation measures that will be implemented with the selected alternative.

4.13 Unavoidable Adverse Impacts

Any alternative would result in adverse environmental effects that cannot be avoided. Protection measures, limitations, and mitigation measure developed in this EIS are intended to reduce the extent and duration of these effects. However, adverse effects cannot be completely avoided. There are two areas under Alternative A where potential risk was identified from the use of some pesticides and fertilizers in certain situations: human health (workers) and ecological resources (wildlife/aquatics). Specifically, the human health risk assessment predicted some worker risk from the use of diazinon, dimethoate, propiconazole, dicamba, and hexazinone in certain situations. In response to these identified risks, however, Alternative B was developed to limit chemical pesticide use such that these estimated worker and ecological risks would be reduced to negligible levels.

The ecological risk assessment predicted that the use of *B.t.* as a biological insecticide could impact populations of non-target beneficial insects in areas immediately adjacent to any treated orchard units. In addition, the use of pesticides could adversely impact bird, reptile, amphibian, and subterranean mammal species from applications of two of the insecticides (chlorpyrifos and dimethoate at Provolt, dimethoate only at Sprague). Most of the estimated wildlife exposures are extremely low, and are several orders of magnitude below the levels of concern. At Sprague, maximum application of fertilizer was associated with a potential risk from ammonia to special status fish species in the main tributary to Jump-off Joe Creek. An analysis of the potential for sublethal effects on special status fish species identified low potential risks for species at and near Provolt under both typical and maximum application assumptions. At Sprague, there are moderate risks of sublethal effects from fertilizers to special status species in Jump-off Joe Creek from maximum applications, and high risks from maximum fertilizer applications for special status species in the main tributary to Jump-off Joe Creek. As described previously, Alternative B was designed in response to the risks identified for Alternative A, to provide limitations on pesticide use that target these risks, and thereby reduce the estimated ecological risks to negligible levels.

There is also potential for additional adverse effects beyond those identified above. However, these also are expected to be negligible given the implementation of protection measures and limitations identified in this EIS. These include:

- Short-term reduction in air quality from dust and engine emissions resulting from IPM activities (power tools and mechanical equipment that burn fossil fuels, prescribed burning, and volatile and drift fraction of pesticides used in chemical methods);
- Temporary increase in fire hazard from waste material (dry vegetation) left on ground after treatment;
- Localized changes in terrestrial wildlife habitat;
- Localized lethal impacts to non-target insects from insecticide use, and to non-target plants from herbicide use; and
- Temporary health effects from prescribed burning (eye, throat, lung irritation).

The potential for adverse effects varies with each alternative and is discussed in greater detail in earlier sections of this chapter. Adherence to protection measures (and, under Alternative B, limitations) would minimize the potential for any adverse environmental effects.

4.14 Relationship Between Short-Term Uses Versus Long-Term Productivity

Short-term uses are generally those that determine the present quality of life for the public, including BLM orchard employees. The short-term use of the orchard is to produce improved seed for conifer seedling production, preserve individual valuable conifer trees, produce native species plants and plant species seed, and produce containerized seedlings in a greenhouse nursery. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects. Long-term productivity refers to the capacity of the soils to support sound ecosystems that produce resources such as forage, wildlife, water, and timber. Long-term productivity for a seed orchard refers to the capabilities of the seed orchard to support production that will continue to sustain adequate quantities of high quality seed. The proposed pest management program is designed to protect and enhance the long-term productivity of the orchard, as well as contribute to the short-term uses.

The cultural and biological pest control methods associated with short-term uses have no known long-term adverse effects on productivity. The pesticides examined in this EIS also should have no adverse effect on long-term productivity because most dissipate in the environment relatively quickly and would not change the productivity of the natural environment.

4.15 Irreversible and Irretrievable Commitment of Resources

Implementation of the proposed IPM program at Provolt and Sprague would result in the commitments of various natural resources and man-made resources. Some of these commitments of resources are irretrievable by virtue of duration of commitment or cost. In other cases, commitments of resources are irreversible since the resource is consumed during IPM implementation.

4.15.1 Irretrievable Effects

Orchard Seed Production

An irretrievable effect on resources is the loss of seed production opportunities. Seed production would vary between alternatives, as would the costs associated with accomplishing environmentally sound pest management. The commitment of time and dollars are irretrievable when production is lost. However, they are not irreversible, since production levels can be reversed by changing orchard pest management strategies in the future.

Seed loss, primarily to insects and disease, would occur under all alternatives, but would have the potential to be highest under Alternative C (Non-Pesticide Pest Management).

Cost Efficiency

Lost efficiencies associated with not using an optimum mix of pest control methods would be irretrievable. Since Alternative A has the most flexibility for using all pest management methods, it should be the most cost-efficient.

4.15.2 Irreversible Effects

The principal irreversible commitment of resources associated with the proposed IPM methods is the use of fossil fuels from the operation of heavy equipment or power tools associated with mechanical methods or the equipment used in application of pesticides and fertilizers. Pest management approaches selected, the mix of which can vary widely even within a single alternative, would determine the level of fossil fuel consumption. For example, hand applications of pesticides and manual vegetation control methods would consume no fossil fuel during the treatment, while mowers or a tractor-mounted sprayer would.

5.0 Consultation and Coordination

Public involvement and interagency/intergovernmental coordination and consultation are recognized as an essential element in the development of an EIS. Public participation has been encouraged and solicited since the original "Notice of Intent to Prepare an EIS" was published in March 1999, and will continue through completion of the Final EIS. A scoping plan was developed in June 2002 when BLM initiated contractor support to complete the IPM EIS (BLM 2002). Agencies and interest groups with special expertise or concerns related to pest management have been notified of the project and advised of the need to coordinate information and provide input. Technical and scientific information available from a variety of sources has been reviewed and considered during the scoping process

5.1 Scoping Process

Table 5.1-1 outlines a chronology of BLM's public outreach for the EIS scoping – starting March 26, 1999, when the first Notice of Intent was published in the *Federal Register*, through July 26, 2002, the official end of the public scoping period for the Draft EIS.

5.2 Persons, Groups, and Agencies Consulted

BLM actively solicited scoping comments from the interested members of the general public, including adjacent and nearby landowners and other public citizens, public interest groups, industry and business, members of the media, libraries, and schools; and requested input from state and Federal officials (including tribal representatives), and Federal, state, and local environmental resource agencies. These persons and groups are identified in more detail in Section 5.3.

Table 5.1-1. Chronology of Scoping Activities

Date	Action
3/26/99	Notice of Intent published in *Federal Register* (one EIS for all four BLM western Oregon seed orchards)
4/99	BLM Medford District news releases (April 1 and April 5) and *Medford's Messenger* (various dates)
4/7/99	Request for comments published in *Illinois Valley News* in Cave Junction, OR
7/19/99	Open house announcement and fact sheet mailed (separate letters for Provolt and Sprague)
8/3/99	BLM Medford District News Release announcing dates of open houses at Provolt and Sprague and requesting public input
8/11/99	Open house at Provolt (12+ attended, including members from Provolt Grange 912)
8/12/99	Open house at Sprague (8 attended)
3/29/01	Revised Notice of Intent in *Federal Register* (indicating decision to prepare three district-specific EISs)
7/1/02	Mailing to interested public advising of additional scoping period and revised EIS schedule (approximately 465 on mailing list for both orchards)
7/1/02	Mailing to interested agencies advising of additional scoping period and revised EIS schedule (approximately 25 on mailing list for both orchards)
7/5/02	Second public scoping period begins
7/5/02	Public notice in local newspaper, *Grants Pass Daily Courier*
7/7/02	Public notice in local newspaper, *Medford Mail Tribune*
7/9/02	Public notice in local newspaper, *Ashland Daily Tidings*
7/26/02	Second public scoping period ends

Numerous members of the public, representing nearby landowners, orchard cooperators, and public interest groups, have commented to date. Two local agencies (Williams Fire and Rescue and the Josephine County Board of County Commissioners) provided scoping comments. In addition, both FWS (Brendan White) and NOAA Fisheries (Dan Tonnes), at the invitation of BLM, conducted site visits of the Provolt and Sprague Seed Orchards on September 25, 2002, and October 29, 2002, respectively, to meet with BLM orchard staff, and identify and discuss potential areas of concern for special status terrestrial and aquatic species. Formal consultation with NOAA Fisheries under Section 7 of the ESA was completed with issuance of biological opinions by NOAA on February 9, 2005; see information summarized in Section 1.4.2. Finally, BLM contractors consulted with the EPA Office of Pesticide Programs and with manufacturers of pesticide products during performance of the risk assessments to request relevant information. Specifically, EPA provided agency-prepared documents that summarize technical studies relevant to the FIFRA registration of the pesticides and the current status of "other" ("inert") ingredients. Pesticide manufacturers provided material safety data sheets and product labels, as well as information on "other" ingredients.

5.3 Draft EIS Review and Comment

A detailed report of the public review and comment process on the Draft EIS is provided as Appendix E to this Final EIS. BLM received very few comments on the Draft EIS. There were no commentors at the Sprague public meetings. There was one commentor at the Provolt public meetings, an individual who identified himself as a volunteer at Provolt and a pest control retiree. Written comments were received from two Federal agencies, an individual representing herself and two organizations, and a private firm. Of the five commentors, three supported the selection of Alternative B (IPM with Environmental Protection Emphasis—the proposed action and preferred alternative) and one recommended that Alternative C (Non-Chemical Pest Management[1]) be selected. One commentor expressed no preference for a selected alternative, and limited comments to suggestions for changes to the details of Alternative B to further protect threatened salmonid species. A summary of the comments received is provided in Table 5.3-1. The comments and detailed responses are provided in Appendix E.

5.4 List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

The current mailing list includes just over 490 names, approximately 465 of which are members of the general public, including adjacent and nearby landowners and other public citizens, public interest groups, industry and business, members of the media, libraries, schools, and state and Federal officials (including tribal representatives); and 25 of which represent Federal, state, and local environmental resource agencies. A breakdown of the state, Federal, and local environmental resource agencies, tribal contacts, and public interest groups is provided below.

The Confederated Tribes of Grande Ronde, Siletz, and Rogue-Table Rock; Cow Creek Band of Umpqua Indians; Shasta Tribe and Shasta Nation were on the mailing list but did

[1] Revised to be named Non-Pesticide Pest Management for Final EIS in response to comment M4-2.

Table 5.3-1. Summary of Public Comments on Draft EIS

Tracking Number	Commentor	Format and Date	Focus
M1	Gordon Nunnally Volunteer at Provolt Seed Orchard Central Point, OR	Provolt Public Meeting 7/15/03	Support for Alternative B and the IPM approach to pest control
M2	Michael P. Tehan National Marine Fisheries Service (NOAA Fisheries) National Oceanic and Atmospheric Administration Portland, OR	Letter dated 8/13/03, received 8/20/03	Suggestions for additional analysis, monitoring, and protection measures for anadromous fish species
M3	Judith Leckrone Lee Manager, Geographic Unit Region 10, U.S. Environmental Protection Agency Seattle, WA	Faxed letter dated 9/10/03, received 9/10/03	Support for Alternative B, pesticide safety, IPM for specific diseases, additional technologies, Port-Orford-Cedar management, pesticides listed in a recent Western District Court decision
M4	Jan Wroncy Individually and representing Coast Range Guardians and Canaries Who Sing Eugene, OR	Letter dated 8/25/03, faxed 8/27/03	Support for Alternative C, opposition to use of pesticides, request to exclude *B.t.* from Alternative C, statement that impacts from pesticides are underestimated and would affect salmon, recommended no use of fertilizers to decrease need for pesticides
M5	Brian A. Schlaefil, Area Chief Forester Boise Building Solutions, Western Oregon Timberlands Medford, OR	Letter dated 8/25/03, received 8/25/03	Support for Alternative B

not comment during scoping.

Agency List (22)

Josephine County Planning Department
Josephine County Forestry Department
Josephine Soil and Water Conservation District
Oregon Department of Agriculture
Oregon Department of Environmental Quality (2)
Oregon Department of Fish and Wildlife (2)
Oregon Department of Forestry
Oregon Department of Land Conservation
Oregon Department of Water Resources
Deputy State Historic Preservation Officer
National Marine Fisheries Service (2)
U.S. Department of Agriculture, APHIS Wildlife Services
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service, Galice Ranger District
U.S. Forest Service, Applegate Ranger District
U.S. Forest Service, Ashland Ranger District

U.S. Forest Service, J. Herbert Stone Nursery
U.S. Forest Service, Siskiyou National Forest
U.S. Forest Service, Umpqua National Forest
U.S. Forest Service, Two Rivers Ranger District
U.S. Forest Service, Rogue River National Forest

Public Interest Groups (34)

1000 Friends of Oregon
Applegate River Watershed Council
Applegate Partnership
Applegate Valley Rural Fire District #9
Associated Oregon Loggers, Inc.
Canaries Who Sing
Coast Range Guardians
Deer Creek Valley Natural Resources
Headwaters
Hugo Neighborhood Association and Historical Society
Rogue Valley Council of Governments
Josephine County Courthouse
Josephine County Board of Commissioners
Klamath-Siskiyou Wildland Center
Missouri Flat Cemetery Association
North Applegate Watershed Protection Association
Northwest Coalition for Alternatives to Pesticides
Northwest Forestry Association
Native Plant Society of Oregon
Oregon Farm Bureau Federation
Oregon Forest Resources Institute
Oregon Public Broadcasting
Oregon Trout
Oregon Wildlife Federation
Pacific Rivers Council
Provolt Community Church
Provolt Grange #912
Association of O&C Counties
Sierra Club
Society of American Foresters
Siskiyou Regional Education Project
The Nature Conservancy
The Oregonian
Williams Town Council

Government Officials (11)

Confederated Tribes of Grande Ronde
Confederated Tribes of Siletz
Confederated Tribes of Rogue –Table Rock
Cow Creek Band of Umpqua Indians
Rep. Greg Walden
Rep. Peter DeFazio
Sen. Gordon Smith
Sen. Jason Atkinson
Sen. Ron Wyden
Shasta Tribe
Shasta Nation

6.0 List of Preparers

BLM Staff (Seed Orchards, Medford District Office, Oregon State Office)

Name	Primary Responsibility	Discipline	Related Professional Experience
Jeannette Griese	Contracting officer's representative State coordinator	Forestry	14 years BLM forester/silviculturist
Harvey Koester	Alternate contracting officer's representative Medford District ID team lead	Seed orchards manager	18 years BLM forester/genetics/ forest pathology 11 years BLM seed orchards manager
Gordon Lyford	Alternate contracting officer's representative	Seed orchards	10 years BLM orchardist – seed orchards 17 years Bureau of Reclamation agricultural engineering, irrigation, water rights
Terry Tuttle	Alternate contracting officer's representative	Seed orchards	28 years BLM forester 3 years BLM orchardist – seed orchards
Dale Johnson	Fisheries	Aquatic resources	15 years BLM 3 years environmental consulting 1 year EPA 10 years Bonneville Power Administration fisheries biologist
Ann Ramage	Cultural resources	Cultural resources	17 years BLM management, cultural resources
Jim Harper	Terrestrial wildlife	Wildlife biology	25 years BLM wildlife biologist
Mark Prchal	Soils	Geology, soils	17 years Forest Service engineering geologist 5 years Forest Service soils
Dave Maurer	Hydrology Soils	Water resources	14 years BLM soils and water 20 years Jackson County (OR), State of Oregon, soils testing lab, consultant (soils and water)
Mark Mousseaux	Vegetation	Botany	12 years Forest Service botanist, forester 3 years BLM botanist
Leslie Frewing-Runyon	Oregon State Office NEPA	Planning and economics	14 years BLM regional economist/ planner

Contract Staff (LABAT-ANDERSON INCORPORATED and Subcontractors)

Name	Primary Responsibility	Discipline	Related Professional Experience
Christine Modovsky	Project manager Alternatives Human health Ecological impacts Risk assessment	Environmental chemistry and risk assessment	15 years risk assessment and NEPA analysis/ compliance (LABAT, EPA, Dept. of Interior)
Kristin Sutherlin	Deputy project manager Socioeconomics and environmental justice Land use Noise Public involvement	Planning and economics	16 years socioeconomics and NEPA analysis/compliance (LABAT, USDA APHIS, University of Maryland)
Susan Smillie	NEPA compliance Public involvement Water resources	Environmental engineering and biology	22 years NEPA analysis/compliance and impact assessment (LABAT, Morrison-Knudsen, Battelle)
Randy McCart	Soils GIS mapping Air quality	Geography	14 years NEPA compliance and impact assessment (LABAT)
John Weeks	Environmental fate modeling Risk assessment	Forestry, biostatistics, biology, and toxicology	23 years fate and transport modeling, risk assessment (SC Johnson, LABAT, Ketron, Environmental Research Associates, Forest Service)
Dr. Jason Sandahl	Aquatic species impacts	Aquatic toxicology	12 years pesticide management and impacts, science research and education, forestry (Oregon State University, Forest Service, Peace Corps)
Dr. William Liss	Aquatic species impacts	Salmonid ecology	26 years science research and education (Oregon State University)
Dr. Jesse Ford	Impact assessment	Ecology	23 years science research and education (Oregon State University, University of Alaska, NCASI, Cornell University, North Shore Consultants, University of Minnesota, Minnesota DNR)
Jody Nelson	Vegetation impacts IPM methods	Botany	12 years ecological impact assessment, science education (LABAT, Denver Botanic Gardens, University of Northern Colorado)
Karin Keifer	Terrestrial wildlife	Biology and animal behavior	4 years ecological impact assessment, research, animal husbandry (LABAT, Sevilleta National Wildlife Refuge, Dallas Zoo, Tantra National Park -Slovakia, Franklin and Marshall College)
Quinn Damgaard	General research and support Cultural resources Aquatic species	Biology	2 years technical writing, lab analysis, vegetation management, public outreach (LABAT, Midwest Laboratories, Pottawattamie County Conservation Board)
Dean Converse	General research and support Air quality	Geography and environmental studies	3 years air quality, environmental analysis (LABAT, Nebraska DEQ)

7.0 References

Certain information cited below was obtained from Internet sites maintained by government agencies or other reliable sources. The Internet citations (uniform resource locators, or URLs) were accurate at the time the data were collected. However, websites change frequently due to changes in data availability or reorganization of information, and the cited URLs may not work in the future. If this occurs, "backing up" to a less specific web address may allow retrieval of the information. For further assistance in locating references cited in this document, please contact the seed orchard manager at the Bureau of Land Management.

Chapter 1

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Acronyms and Abbreviations

°F	degrees Fahrenheit
µg/m³	micrograms per cubic meter
µm	micron, micrometer
a.i.	active ingredient
AQCR	air quality control region
AQMA	air quality maintenance area
ATV	all-terrain vehicle
BLM	Bureau of Land Management
BMP	best management practice
B.t.	*Bacillus thuringiensis*
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CX	categorical exclusion (under NEPA)
dB	decibel
dBA	"A-weighted" decibel
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
EXAMS	Exposure Analysis Modeling System
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLPMA	Federal Land Policy and Management Act
FONSI	finding of no significant impact
ft	foot or feet
ft²	square feet
FWS	U.S. Fish and Wildlife Service
gal	gallon
GLEAMS	Groundwater Loading Effects of Agricultural Management Systems
in	inch or inches
IPM	integrated pest management
kg	kilogram
lb	pound(s)
LC_{50}	median lethal concentration
LD_{50}	median lethal dose
L_{eq}	equivalent sound level
MATC	maximum acceptable toxicant concentration
meq/g	milliequivalents per gram

min	minute
mg	milligram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
NA	not applicable / not available
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NH_3	ammonia
NH_4^+	ammonium ion
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWSOMA	Northwest Seed Orchard Managers Association
O_3	ozone
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OWRD	Oregon Water Resources Department
PAH	polynuclear aromatic hydrocarbon
Pb	lead
PCI	per capita income
PLO	public land order
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
ppm	parts per million
Q	quotient
RfD	reference dose
RMP	resource management plan
ROD	record of decision
ROI	region of influence
SDWA	*Safe Drinking Water Act*
SEIS	supplemental environmental impact statement
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SWAP	source water assessment program
TPI	total personal income
UGB	urban growth boundary
UIC	underground injection control
URL	uniform resource locator (web site address)
USBC	U.S. Bureau of the Census
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

Glossary

Note: All definitions are specific to their use in this environmental impact statement. Additional terms specific to the recently conducted risk assessment are found in Section 10 of the risk assessment reports.

Acaricide. An insecticide that specifically targets mites and ticks.

Active ingredient. The pesticidally active chemical contained in a pesticide product.

Acute. Single-dose toxicity study. May also refer to adverse effects that exhibit a short and relatively severe course.

Adsorption. Adhesion of substances to the surfaces of solids or liquids; technically, the attraction of ions of compounds to the surfaces of solids or liquids.

Anadromous. Fish that are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn.

Analysis. The second step of an ecological risk assessment, which examines the two primary components of risk–exposure and effects–and the relationships between each other and ecosystem characteristics.

Biological control. The use of natural enemies to attack a target plant, insect, or animal pest.

Boom. A tubular metal device that conducts a pesticide or fertilizer mixture from a tank to a series of spray nozzles. A boom may be mounted beneath an aircraft or behind a vehicle.

Broadcast application. The applying of pesticide or fertilizer over an entire area or field rather than only to rows, beds, or individual plants.

Buffer (strip or zone). A zone left untreated with pesticide or fertilizer (at the outer edge of a treated area or along streams) as protection against the effects of treatment.

Cancer slope factor. Represents the probability that a 1-mg/kg/day chronic dose of a chemical will result in formation of a tumor. Expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

Canopy. The uppermost level of a forest community, usually formed by the tallest trees.

Carcinogen. A substance producing or inciting cancer.

Categorical exclusion. A category of actions that do not individually or cumulatively have significant effects on the human environment and for which neither an environmental assessment nor an environmental impact statement is required.

Cation exchange capacity. The capacity of a soil to adsorb cations (positively charged ions), expressed in milliequivalents per 100 grams of soil.

Chemical degradation. The breakdown of a chemical substance into simpler components through chemical reactions.

Chemigation. The injection of pesticides and fertilizers through irrigation systems.

Chronic. Long-term, usually lifetime or near lifetime in duration.

Clonal orchard. A production unit consisting of plants that are genetically identical to the parent plant; they are produced asexually, e.g., from cuttings or suckers.

Control. Reduction of a pest problem to a point where it is below an acceptable threshold.

Critical habitat. (1) Specific areas within the habitat occupied by a species at the time it is listed under the *Endangered Species Act* where there are physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and (2) specific areas outside the habitat occupied by the species at the time it is listed upon the determination by the Secretary of the Interior that such areas are essential for the conservation of the species.

Cultural resources. Remains of human activity, occupation, or endeavor, reflected in districts, sites, structures, building, objects, artifacts, ruins, works of art, architecture, and natural features that were of importance in past human events. Cultural resources consist of (1) physical remains, (2) areas where significant human events occurred, even though evidence of the events no longer remains, and (3) the environment immediately surrounding the actual resource.

Cumulative impact. The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time

Dose. The amount of chemical entering the body.

Drift. The movement of airborne particles by air motion (wind) away from an intended target area.

Endangered species. Plant or animal species that are in danger of extinction throughout all or a significant part of their range.

Environmental assessment. A systematic environmental analysis of site-specific activities used to determine whether such activities would significantly affect the human environment, and whether an environmental impact statement is required.

Environmental impact statement. An analytical document developed for use by decisionmakers to weigh the environmental consequences of a potential action.

Ephemeral stream. A stream that flows only in direct response to precipitation and whose channel is at all times above the water table.

Exotic plants. Plants that are not native to the region in which they occur.

Exposure assessment. The second step in human health risk assessment, involving estimation of doses from various scenarios and routes of exposure.

Fertilizer. Any of a large number of natural or synthetic materials, including manure and nitrogen, phosphorus, and potassium compounds, spread on or worked into the soil to increase its fertility.

Forb. A low-growing herbaceous plant that is not a grass, sedge, or rush.

Formulation. A specific composition of pesticide active ingredient(s) and other ingredients, comprising a pesticide product.

Girdling. A physical cutting or disruption of the cambial sap flow within a tree.

GLEAMS. Groundwater Loading Effects of Agricultural Management Systems, a computer-based model for predicting the fate and transport of agricultural pesticides and fertilizers.

Ground cover. Grasses or other plants that keep soil from being blown or washed away.

Habitat. The environment in which an organism occurs.

Half-life. The time required for a chemical to degrade to 50% of its original concentration.

Hazard assessment. The first step in human health risk assessment, in which each chemical's toxic properties and dose-response relationship are identified.

Hazard index. An indicator of risk to human health, representing the ratio of the estimated dose to the reference dose. A hazard index of 1 or less usually indicates negligible risk to human health.

Infiltration. The downward or lateral entry of water into the soil.

Integrated pest management. Use of several techniques (for example, burning, grazing and mechanical, manual, or chemical methods) as one system to control pests where they are unwanted. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels and to limit the impact on other organisms and the environment.

Intermittent stream. A stream that flows only at certain times of the year when it receives water from winter rain or melting snow.

LC_{50}. The concentration of a chemical in water at which 50 percent of test animals were killed. It is usually used in testing of fish or other aquatic animals.

LD_{50}. The dosage of toxicant (expressed in milligrams of toxicant per kilogram of animal body weight) required to kill 50 percent of the animals in a test population.

Leaching. The movement of chemicals through soil by water.

Lowest-observed-effect concentration. The lowest chemical concentration in water at which adverse effects are observed in an aquatic toxicity study.

Maximum acceptable toxicant concentration. The geometric mean of a no-observable-effect concentration and a lowest-observed-effect concentration.

Mean. The average of a set of values.

Median. The middle value in a ranked distribution.

mg/kg. Milligrams per kilogram, usually indicating a dose level in terms of milligrams intake of a substance per kilogram of body weight.

mg/kg/day. Milligrams per kilogram per day, usually indicating a daily dose level in terms of milligrams intake of a substance per kilogram of body weight per day.

mg/L. Milligrams per liter, usually indicating a concentration of a substance in water.

No-observed-effect concentration. The highest water concentration at which no adverse effects are observed in an aquatic toxicity study.

Noxious weed. According to the *Federal Noxious Weed Act* (FL 93-629), a weed that causes disease or has other adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

Perennial stream. A stream that flows continuously year round.

Pesticide. Any substance or mixture of substances intended for controlling insects, rodents, fungi, weeds, or other plants and animals that are considered pests.

Phytophagous. An organism that feeds on plants, particularly an insect that feeds on shrubs or trees.

Prescribed burning (prescribed fire). The scientific, intentional burning of wildland fuels in either their natural or modified states under conditions to allow the fire to continue to a predetermined area and to produce the intensity of heat and rate of spread needed to meet certain objectives.

Problem formulation. The first step in an ecological risk assessment, in which the purpose of the assessment is provided, the problem is defined, and a plan for analyzing and characterizing risk is determined.

Raptors. Birds of prey, such as owls, hawks, or eagles.

Receptor. An ecological entity that is exposed to a stressor.

Reference dose. An estimate of the highest possible daily dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime.

Riparian. Pertaining to or located along a stream bank or other water bodies, such as ponds, lakes, reservoirs, or marshes.

Risk characterization. The third step in both human health and ecological risk assessment, in which estimated doses are compared to a chemical's toxic properties to predict the potential for adverse effects under the given conditions of exposure.

Risk. The probability that a substance will produce harm under specified conditions.

Rogue. To systematically cull individual trees and/or families considered no longer desirable within the seed orchard population. Roguing is used to increase genetic gain potential in an orchard. Theoretically, the more intensive the roguing, the greater the genetic improvement.

Runoff. The part of the precipitation in a drainage area that is discharged from the area in stream channels, including surface runoff, ground water runoff, and seepage.

Scoping. The process by which significant issues relating to a proposal are identified for environmental analysis. Scoping includes eliciting public comment on the proposal, evaluating concerns, and developing alternatives for consideration.

Soil compaction. The compression of the soil profile from surface pressure, resulting in reduced air space, lower water-holding capacity, and decreased plant root penetrability.

Sorption. The process of taking up or holding by either absorption or adsorption.

Special status species. Species which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the *Endangered Species Act;* those listed by a state in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

Spot treatment. Applying pesticide to a selected individual area (as opposed to broadcast application).

Stressor. Any physical, chemical, or biological entity that can induce an adverse response.

Threatened species. A plant or animal species that is not in danger of extinction but is likely to become so within the foreseeable future throughout all or a significant portion of its range.

Trade name. The commercial name of a pesticide product.

Water table. The upper limit of the part of the soil or underlying rock material that is wholly saturated with water.

Weed. A plant out of place or growing where not desired.

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Appendix A: Seed Orchard Pests

This appendix provides detailed information on the more common and damaging insects and diseases that have been found at the Provolt and Sprague Seed Orchards, or commonly found in forests in southwestern Oregon and capable of causing damage to the conifer species grown at the orchards. Information on weeds and animal pests is provided in Chapter 1. It is not intended to be a complete guide to orchard insects and diseases in the Pacific Northwest Region.

Insects

Douglas-fir cone gall midge (*Contarinia oregonensis*)
Adults are flies 3-4 mm in length, which emerge in early spring. The females lay eggs near the base of the cone scale in newly opened flowers. When the egg hatches, the larva tunnels into the young cone scale and forms a gall. When the mature cones become wet in the fall, the larvae drop to the litter and pupate. Cocoons are spun in the litter, and overwintering occurs in prepupal and pupal stages. Seeds may be fused to the scale when only a few larvae are present or completely destroyed when numbers are large. This insect can be a major destroyer of Douglas-fir seeds; severe infestations can destroy all seeds in the cone. This insect has been found at the Provolt Seed Orchard and causes damage to Douglas-fir cones in the orchard.

Fir coneworm (*Dioryctria abietivorella*)
As a group, coneworms are one of the most important North American lepidopterous cone pests. Life cycles and preferred hosts vary between species of coneworms. White fir, Douglas-fir, ponderosa pine, and sugar pine cones may be attacked. The adults are moderate-sized, drab-colored moths with mouth parts that are somewhat snout-like. Larvae can bore into the cambium of the trunk, branches, and shoots or into fresh green cones. The larva feeds voraciously, tunneling indiscriminately through the scales and seeds. One larva can destroy an entire cone. A heavy infestation can destroy 100% of the Douglas-fir cone (and seed) crop. This insect has been found at the Provolt and Sprague Seed Orchards, and causes heavy damage to Douglas-fir cones at Provolt and moderate damage to sugar pine cones at Sprague.

Douglas-fir cone moth (*Barbara colfaxiana*)
Adult cone moths are grayish brown in color with forewings transversely banded with gray, silver, and brown. The moth emerges in spring and the female lays eggs on the cone bract. The larva feeds first in scale tissue, but soon moves to the central seed-producing portion of the cone, where it mainly feeds on seeds. By the end of July, they pupate in a tough pitch-coated cocoon in the center of the cone. Feeding tunnels around the cone axis sharply reduce seed production. External evidence of damage differs depending on cone size. This insect is one of the major pests of Douglas-fir cones. One larva may destroy up to 60% of the seeds in a cone. Pupae may remain in diapause for one to three years in the old cones after they have fallen from the trees.
This insect has been found at the Provolt Seed Orchard and causes damage to Douglas-fir cones in the orchard.

Western conifer seed bug (*Leptoglossus occidentalis*)
The broad flat tibia of the hind legs characterizes the western conifer seed bug, also called the leaf-footed bug. It feeds upon and damages the seed of Douglas-fir, sugar pine, and ponderosa pine. The adults are 15 to 18 mm long, and are reddish brown to dark gray with dense whitish pubescence. The seed bug overwinters in the adult stage and emerges in May or June; there is one generation per year. The eggs are deposited in rows on the needles from June until mid-August. Seed bug nymphs feed in the ovules and can cause conelet abortion. Later nymphal instars and adults feed on seeds. No

external damage is visible on the cones. Both adult and nymph stages insert their long proboscises into cones to suck juices from the seeds, while the bug remains on outside of cone. Feeding by this insect lowers the quality of the seed crop, and heavy feeding can cause up to 40% loss of Douglas-fir seed crop. This insect has been found at the Provolt and Sprague Seed Orchards and causes damage to Douglas-fir cones at Provolt and sugar pine and ponderosa pine cones at Sprague.

Douglas-fir seed chalcid (*Megastigmus spermotrophus*)
The species of this genus include pests of a wide range of conifers. All species are highly specialized in their method of attack and feeding habits. Several species are found attacking Douglas-fir and true fir; however, only one species is known to attack pine (*M. albifrons*). The adults are small antlike wasps, which may be black to brown, or yellowish in color. The females are larger (about 4.0 mm long) with a long curved ovipositor. Eggs are deposited into immature seeds. Larvae feed only on seed contents, each one destroying a single seed. After devouring the contents, it remains within the seed coat. There is no external evidence of damage on the seeds until the adult emerges, after which a clearly defined emergence hole is evident. Larvae remain over winter in the seeds, either in the cone or in the litter under trees in the orchard. It pupates in the spring. This insect has been found at the Provolt Seed Orchard and causes damage to Douglas-fir seed at the orchard, evident in the X-rays of cleaned seed after harvest and seed extraction.

Sugar pine cone beetle (*Conophthorus lambertianae*)
There are eleven species of this genus in western North America, and the beetle species are often specific to a tree species, such as sugar pine, ponderosa pine, and western white pine. The small, shiny black, cylindrical adult beetles attack and kill second-year conelets beginning in early spring through August, killing the elongating cones and preventing the production of viable seed. The beetles overwinter as adults in cones or mined twig tips. The females first fly to cone and enter the stem of the cone, mine into the cone along the axis, and are followed by males and other females. Eggs are laid in the cone and larvae feed and pupate within the dying cones. Cone loss often exceeds 90% of the crop in local areas. This insect has only rarely been found at the Sprague Seed Orchard, but causes heavy damage to sugar pine cones in the surrounding forests.

Douglas-fir twig weevil (*Cylindrocopturus furnissi*)
This insect pest attacks young open-grown Douglas-fir weakened by improper planting or environmental stress, such as drought, poorly drained soils, or sun scald. Damage to the upper stem of sapling size trees can result in forking and poor form. The damage appears as a scattering of dying small branches on two-year old growth or on the main stem of smaller trees. Weevil presence can be confirmed by locating larvae of an L-shaped pupation chamber in the xylem and pith of the dead stem tissue. The adults are small (3 mm) and brown colored, and the larvae are white and legless. This disease has been found occasionally at Provolt Seed Orchard.

Bark beetles and wood borers
A variety of small, dark-colored, winged beetles bore into standing green trees or downed slash material, or lay eggs on the bark surface of standing green trees or dead and downed trees. These damaging forest insects are ubiquitous throughout the forest, are specific to host trees, and maintain fairly consistent populations during normal conditions, but increase significantly during stressful events or conditions. Under normal circumstances, vigorous, healthy trees have unique capabilities to resist beetle attack. However, under adverse conditions such as disease infection, heat and drought damage, mechanical damage, high water tables, nutrient deficiencies, or a variety of other stress-related tree conditions, the insect populations increase and infest weak trees, as well as healthy nearby trees.

An adult insect generally emerges in spring from a tree infested the previous year and flies to a susceptible green tree, where it excavates an egg gallery in the fresh phloem

tissue. When the eggs hatch, the larvae bore away from the egg gallery and construct a mine that gradually increases in length and width. The pattern of adult and larval mines is distinctive for each insect species. The larvae pupate in the wood and overwinter as pupae or adults. Some species produce more than one generation in a year.

The trees are killed by fungi introduced into the tree by beetles feeding and boring in the phloem tissue, and the fungi expanding into the xylem tissue, obstructing the transport of water to the tree crown. The beetle galleries themselves also can become so numerous that the tree is girdled by insect activity.

Disease

Armillaria root rot (_Armillaria_ spp.)

Armillaria root disease is the most common and most widely distributed forest root disease in Oregon and Washington. It is often found affecting trees that have been weakened by other agents, particularly drought or poorly drained soils. Symptoms of *Armillaria* root disease include thin and/or chlorotic foliage; distress cone crops; abundant resin flow, or leaching of brown liquid at tree bases; a yellow-stringy root and butt rot; and tree mortality. Crown and root collar symptoms occur on only 15-20% of the living infected trees with disease centers; infection in the remaining trees is virtually undetectable. Virtually all trees and other woody species in Oregon and Washington can be damaged by *Armillaria* root disease. It can locally be very severe in southwestern Oregon. In general, white fir is the most susceptible. Mortality caused by the disease is most common in Douglas-fir plantations between the ages of 10 and 25. Tree death after age 25 is uncommon unless the trees are stressed. The disease in Douglas-fir is often associated with poor planting technique, use of planting stock that is not adapted to a particular site, wounding, inadequate drainage, or soil compaction. Affected trees can be windthrown but tend to die standing. Tree death by the disease will often increase one to two years after severe droughts or nearly complete defoliation by insects. Spread of the disease from infected stumps or trees to adjacent healthy trees occurs mainly by mycelia growing across root contacts and, to a lesser extent, by rhyzomorphs that form after a stump or large root system has been colonized. Once a root is infected, the fungus can spread distally and proximally within it. This disease has been found at the Sprague Seed Orchard and occasionally at the Provolt Seed Orchard.

Annosus root rot (*Fomes annosus*)

Annosus root rot is caused by the fungus *Fomes annosus* and occurs throughout the Pacific Northwest. Estimates of losses caused by this disease have not been made for Oregon and Washington, but it is believed to be the third most damaging root disease in the two states after laminated root rot and *Armillaria* root disease. Losses due to annosus root disease are known to be increasing. All conifers can be affected, but there are differences among species in degree of susceptibility and damage. In the Pacific Northwest, western hemlock, mountain hemlock, grand fir, white fir, and Pacific silver fir are highly susceptible and can be severely damaged. Douglas-fir, western redcedar, incense cedar, Port-Orford-cedar, western larch, western white pine, sugar pine, Engelmann spruce, and Sitka spruce are slightly susceptible and rarely damaged. Pines in southwestern Oregon are rarely affected.

This disease is more difficult to identify than are other common root diseases. It causes variable symptoms. Some hosts, especially true firs, frequently die without showing crown symptoms. Other hosts, particularly pines, exhibit decreased terminal growth, needle yellowing, and crown decline prior to death. The disease infects its hosts in two ways: by windblown spores depositing and germinating on freshly exposed wood, and by mycelial growth from diseased roots to healthy roots via contacts. The disease causes two kinds of damage: tree mortality and wood loss through decay. Tree death is the usual result of infection in resinous hosts. Trees killed by the disease tend to die standing

rather than be windthrown. Mountain pine beetles and western pine beetles often attack infected pines. This disease has been found at the Sprague Seed Orchard.

Laminated root rot (*Phellinus weirii*)
Laminated root rot is caused by the fungus *Phellinus weirii*. It is the most damaging root disease in the Pacific Northwest, estimated to cause annual losses of 32 million cubic feet of wood in western Oregon and Washington. Douglas-fir, mountain hemlock, white fir, and grand fir are especially susceptible; pines and cedars are considered to be tolerant or resistant and are seldom infected and killed. Crown symptoms of affected trees include retarded leader growth; short, sparse, and chlorotic faded foliage; and distress cone crops. Crown symptoms are usually not seen until at least half of the host root system is affected. Only about half the infected trees in a disease center will have crown symptoms. Laminated root rot extensively decays roots of highly susceptible host trees and either causes windthrow or kills the trees by destroying their ability to take up water and nutrients. Infected saplings and small poles usually die standing; larger trees are more likely to be windthrown. Infected trees may suffer growth loss for several years prior to death. Laminated root rot often predisposes highly susceptible hosts to bark beetle. Spreading of the disease is all by mycelia on or within the roots. The fungus can persist from tree generation to generation in infested areas and can be considered a disease of the site. It can survive up to 50 years in large roots and stumps of dead or cut trees, and can infect trees that become established nearby by growing across root contacts. This disease is found mostly in forested areas with a site history of its occurrence, and likely not to be found in non-forest conditions.

***Phytophthora* root rot (*Phytophthora* spp.)**
Hosts include a range of conifer species, primarily Douglas-fir and true fir. Infection by *Phytophthora* species results in decay and loss of roots. Depending on the degree of infection, seedlings may be killed, stunted, or show no above-ground symptoms. Because the fungus needs high soil moisture to sporulate and infect, the disease is most common in low, poorly drained areas. In these wet areas, 100 percent of seedlings may be killed or culled, although usually less than 1% of a crop is lost to *Phytophthora*. This disease has been found at the Sprague Seed Orchard causing damage and mortality to older trees in wet conditions or other stress conditions.

Black stain root rot (*Leptographium wageneri*)
This disease can be found in most parts of Oregon and Washington, but is far more common west of the Cascade Range. It tends to be most widely distributed and most damaging in southwest Oregon. Black stain is a vascular wilt-type disease rather than a true root rot, colonizing the water-conducting tissues of the roots, root collars, and lower stems, ultimately blocking the movement of water to the foliage. Infected trees experience severe moisture stress, decline rapidly and die. Often, disease-weakened trees are infested by bark beetles and woodborers at the root crown area. Black stain causes crown symptoms similar to those of other conifer root diseases, including sudden reduction of terminal growth, partial loss of older needles, foliage chlorosis, and production of distress cone crops. Douglas-fir is the most common host of black stain in the Pacific Northwest, where centers of black stain root disease usually are found in 15-25 year old plantations or in heavily stocked patches of natural regeneration. It is believed that Douglas-fir over 30 years old develop substantial resistance to the disease. With other hosts, the disease affects trees of all ages in relatively pure stands. Long-distance spread of the fungus involves insect vectors, predominantly root-feeding bark beetles (*Hylastes nigrinus*) and weevils (*Steremnius carinatus* and *Pissodes fasciatus*). This disease is found in the forests of southern Oregon, but has not been found at either Provolt or Sprague Seed Orchards.

White pine blister rust (*Cronartium ribicola*)
White pine blister rust is caused by an obligate parasite that attacks sugar and western white pines and several species of Ribes. The fungus needs the two alternate hosts to

survive, spending part of its life on 5-needled pines and the other on Ribes. Infection of pines results in cankers on branches and main stems, branch mortality, top kill, and tree mortality.

Spores (aeciospores) produced by the fungus in the spring on pine bole or branch cankers are wind-disseminated to Ribes where they infect the leaves. Spores (urediospores) produce orange pustules on the underside of the leaves that infect other Ribes throughout the summer, resulting in an intensification of the rust. A telial spore stage forms on Ribes leaves in the fall. Teliospores germinate in place to produce spores (sporidia) which are wind-disseminated to pines and infect current year needles. Following infection, the fungus grows from the needle into the branch and forms a canker. After two or three years, spores are produced on the cankers and are spread to Ribes to continue the cycle. Although blister rust may spread hundreds of miles from pines to Ribes, its spread back to pines is usually limited to a few hundred feet.

Environmental conditions are critical for successful infection and limit the disease in some years. Moisture and low temperatures must coincide with spore dispersal. This disease has been found at both Sprague and Provolt Seed Orchards.

***Phomopsis* canker (*Phomopsis lokoyae*)**
Infection of two-year-old stem tissue occurs early in the second growing season, resulting in a canker at the base of the new growth, which girdles the stem. The part of the shoot distal to the canker is killed. The disease appears periodically in the Pacific Northwest, typically 1 or 2 years after droughts. It is associated with prolonged periods of warm weather during budburst. Douglas-fir is most susceptible to this pest. This disease has been found occasionally in Provolt Seed Orchard, causing light damage to Douglas-fir.

***Rhabdocline* needlecast (*Rhabdocline pseudotsugae*)**
Rhabdocline needlecast is occasionally common, but seldom damaging in Douglas-fir stands. Yellow and purple blotches appear on infected needles in the fall and following spring. Needles drop one year after infection. Purplish-pink fruit bodies break through the undersides of one-year-old needles in May to June, exposing orange-brown spores. Spores released from them are windborne and require considerable moisture to germinate. Only the current season's needles are susceptible. There is considerable variation in the susceptibility of Douglas-fir to this disease. In general, coastal Douglas-fir is less susceptible than the inter-mountain variety, and local seed source stock is less susceptible than offsite stock. However, trees within any stand show different levels of infection (many are immune). Disease is most common on trees 5-30 years old. This disease has been found at Provolt Seed Orchard, causing light damage to Douglas-fir.

Douglas-fir rust (*Melampsora occidentalis*)
Native *Melampsora* rusts attack a wide variety of conifer hosts that belong to a number of different genera, including Douglas-fir (one of the primary hosts). *Melampsora* rusts attack the foliage of young primary hosts, most severely in the regeneration and sapling stages. The infected needles are killed and, in years of severe infections, all current year's foliage may be eliminated, resulting in growth reduction. Occasionally, cone scales are attacked, but no damage to seed occurs as happens with cone rusts. All foliage rusts cause yellow to orange discoloration or spots on the foliage of their hosts. For *M. medusae* and *M. occidentalis*, host alternation appears to be obligatory; that is, the presence and proximity of both poplars and conifers is necessary for the rust's survival. Basidiospores from secondary hosts infect the new foliage of the primary hosts in spring, and aecia begin to appear on the primary hosts approximately two weeks after infection. The aeciospores infect the secondary hosts during the summer, and uredinia begin to appear on them approximately two weeks after infection. Uredeniospores spread and intensify the rust on its secondary hosts. Toward fall, telia, instead of uredinia develop on the secondary hosts. They overwinter in a state of dormancy in dead leaves on the ground and germinate the following spring, at a time when young shoots of the primary

hosts begin to break forth from their buds. This disease has been found at Provolt Seed Orchard, causing light damage to Douglas-fir.

Lophodermella* Needlecasts (*Lophodermella spp.)
Several species of fungi in the genus *Lophodermella* cause needle casting of Pacific Northwest pines. Appearance of the disease is sporadic and strongly influenced by weather conditions. Trees are seldom killed directly by Lophodermella needlecasts. Affected needles turn brown in spring of year following infection; trees take on a scorched appearance; needles are cast. If trees are infected for several years, trees become weak and unthrifty, with most living needles near the ends of the branches. New host needles are infected by windborne and rain-splashed spores in early summer; only succulent, young-needles are infected. Symptoms appear the following year. The disease is most serious on young or small trees, in over-stocked, dense tree conditions. This disease has not been found in the orchards, but is found in ponderosa and sugar pines in the forests of southern Oregon.

***Atropellis* Canker (*Atropellis piniphilia* and *A. pinicola*)**
Atropellis canker of pines is caused by two fungi. The disease is especially damaging on lodgepole pine but also affects western white, ponderosa, and sugar pines. Signs of the disease include elongated, flattened depressions, covered with roughened bark on stems and branches; heavy resin flow; dead branches; misshapen stems; and occasional mortality of small trees. Small black or dark brown fruit bodies (apothecia and conidial stromata) form on dead bark and a dark bluish stain appears in the wood behind cankers. The disease is spread by windborne spores which infect new hosts throughout the growing season. The spores are not released until fruiting bodies are moistened. Cankers may continue to produce spores several years after tree death. Most infection occurs through unbroken bark in the nodal region, though some infection occurs through branch stubs. Open grown trees are less subject to infection than trees in overstocked stands. This disease has been found occasionally at Sprague Seed Orchard in the sugar and ponderosa pine orchards.

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Appendix B: Monitoring Plan

Note: *This monitoring plan would be modified as necessary to address the differences between the various pesticides and application methods, and to respond to the results of on-going monitoring.*

B.1 Water Quality Monitoring

B.1.1 Goal

The goal of the Medford District Seed Orchards water quality monitoring plan is to ensure water quality is protected during and after IPM activities.

B.1.1 Background

Agencies and the public are concerned that pesticide or fertilizer application in the Provolt and Sprague Seed Orchards may enter streams and groundwater, contributing to concentrations which exceed those known to have impacts to human and aquatic life. Special status salmonid species occur in direct proximity to some actively managed orchard units at Provolt, and one mile or more from the Sprague Seed Orchard.

The Human Health and Non-Target Species Risk Assessments for Pest Management at the Provolt and Sprague Seed Orchards indicate the use of pesticides or fertilizers poses minimal threat to water quality with one possible exception: in the unlikely event that conditions favoring maximum runoff are present following maximum levels of fertilizer application at Sprague.

Protection measures (best management practices) planned for use in any future pesticide or fertilizer application project, and limitations in the EIS proposed action, are expected to minimize the potential water quality and other environmental impacts from drift and runoff. Monitoring the protection measures and limitations, documenting impacts, and adjusting practices based on this knowledge are part of the monitoring plan.

This plan provides general direction for water quality monitoring whenever a pesticide or fertilizer covered under the EIS is proposed for use. The plan covers four types of monitoring: implementation monitoring, effectiveness monitoring, validation monitoring, and compliance monitoring. The implementation monitoring is intended to document the protection measures and limitations that are actually implemented. The effectiveness component documents how well these measures performed in avoiding introduction of chemicals to the aquatic and groundwater system. The effectiveness data would also be used to further validate that water quality modeling conducted for the Human Health and Non-Target Species Risk Assessments was conservative for orchard units. Compliance monitoring would be used to document domestic water quality and chemical fate.

The Sprague and Provolt Seed Orchards are fortunate to be the beneficiary of previous similar monitoring activities conducted by the Horning and Tyrrell Seed Orchards. Water quality monitoring of an aerial esfenvalerate application at Horning during the spring of 2001 documented that introduction of drift is possible despite implementation of standard protection measures. Monitoring of a similar spray project in 2002 documented control of drift through implementation of additional stream-specific protection measures. (Note that no aerial applications are proposed at Provolt or Sprague.) During

both periods of monitoring at Horning, surface runoff from the orchard units was found to be an insignificant pathway for esfenvalerate transport as almost all actual and potential rainfall infiltrates the soil surface. No concentrations of esfenvalerate were recorded in stream-flow samples during peak storm flow periods. This monitoring indicates that risk assessment estimates of chemical concentrations in surface runoff are very conservative and significantly over-estimate the potential for runoff and concentrations of exposure. The predicted model values have inherent uncertainty in terms of pesticide movement through subsurface pathways of preferential flow. During the April 2003 aerial esfenvalerate application at Tyrrell, drift was limited to less than 50 feet with one drift card drift card being hit 30 feet away from the spray boundary. Runoff monitoring is still in progress.

Protection measures utilized in the Horning 2002 spray project, similar measures included in the Sprague and Provolt EIS proposed action, and orchard operational plans are expected to minimize the potential water quality impacts from drift, runoff, irrigation, and spill. Monitoring the protection measures, documenting impacts, and adjusting practices based on this knowledge are part of the EIS design features.

B.1.3 Overall Objective

The overall objective of the monitoring program at the Provolt and Sprague Seed Orchards is to document the impacts of IPM actions on water quality, and to use this information to continue or modify the protection measures needed to meet the requirements for a healthy aquatic ecosystem. A full assessment of protection measures used in the orchards requires monitoring both groundwater and surface water. Documentation would focus on the following monitoring questions, which were formulated based on public concerns and prior monitoring results at Tyrrell and Horning.

B.1.4 Specific Monitoring Questions

1. Does drift of pesticides occur?

   Method: Monitor all high-pressure hydraulic sprayer applications to ensure compliance with protection measures and to document application rates, environmental conditions, and the actual occurrence of drift.

2. Does application of pesticides or fertilizers result in measurable concentrations in the streams associated with the treated fields?

   Method: Conduct effectiveness monitoring to ensure that the implemented protection measures were effective in preventing drift, surface runoff, and subsurface runoff from entering surface water.

3. What are the measured pesticide concentrations in domestic, irrigation, and monitoring wells downgradient of treated orchard units?

   Method: Conduct annual water sampling of wells to document any chemical concentrations in the groundwater.

4. If a spill occurs, what is the potential for surface water and groundwater contamination and what are the resulting concentrations in the associated stream and groundwater area?

   Method: Depending on the type and amount of chemical, conduct surface water, groundwater, air, and soil monitoring to comply with the ODEQ Hazardous Substance

Remedial Action Rules (OAR 340-122). At a minimum, sample downslope streams and the immediate groundwater table, if present. Conduct sampling of orchard domestic well if in proximity to spill.

5. What are the cumulative effects of the most toxic pesticides included in the IPM program?

   Method: Conduct fall / winter monitoring of select waterways for analysis of select chemicals applied during the previous season.

The overall strategies to address these questions and apply these methods are provided in the following section.

B.1.5 Monitoring Strategies

B.1.5.1 Implementation Monitoring

All pesticide and fertilizer applications would be documented by the orchard manager or designated representative. Items to be documented include type of chemical applied, date of application, method of application, area treated, amount applied, precipitation for the three days preceding and following application, location used for mixing and loading, wind direction and speed, relative humidity, air temperature, and notes regarding whether any leakage or spills occurred. A list of all protection measures and limitations for each orchard unit receiving pesticide or fertilizer application would all be provided in the Annual Provolt and Sprague Seed Orchards Monitoring Report.

Implementing protection measures and analyzing monitoring data of all types depends heavily on quality climate information. Informed decisions involving chemical application rely on access to on-site weather data. Maintenance of the existing seed orchard weather stations (RAWS) would continue providing real-time climate data including air temperature, precipitation, wind speed, wind direction, and relative humidity. These data would provide documentation of compliance and information to predict runoff patterns for effectiveness and validation monitoring.

B.1.5.2 Effectiveness Monitoring

Drift

Drift Card Monitoring

All orchard units adjacent to flowing streams and planned for high-pressure hydraulic sprayer applications of chemicals would have spray cards placed so drift from the application can be captured and characterized. Orchard units or treatment areas directly adjacent to open water (within 100 feet) would require drift cards be placed at a maximum of 100-foot intervals along the edge of the orchard unit prior to the application. If open canopy occurs in the waterway buffer, drift cards would be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Immediately after the application, the cards would be collected and reviewed to determine if a drift signature is present, the extent of the drift, and the potential for aquatic contamination. A copy of all the cards would be kept on file at the seed orchard along with a record of their location and all the compliance monitoring documentation.

Surface Water Monitoring

Water samples would be taken in streams before and during the 24 hours after spray application, dependant on the type of chemical, the distance from water and the application method. The time of collection would be based on the time of concentration

measurements in the flowing channels associated with the treatment areas. Selection of sampling stations for surface water sampling would be based on the proximity to application areas.

All data would be used in conjunction with the spray cards to determine the effectiveness of the full "suite" of protective measures implemented to avoid drift. Samples would be analyzed at a state-certified laboratory that has detection limits of 0.02 parts per billion (ppb) for most of the potential pesticides. Samples would be collected in accordance with laboratory instructions. When sites are sampled, additional interpretive data would be collected for pH, specific conductance, turbidity, and temperature.

Runoff

Surface Runoff

Pesticide and fertilizer fate modeling from the risk assessment indicates that field runoff events within the first six months after spray application have the highest probability for carrying detectible concentrations of chemicals. One study (Rashin and Graber 1993) determined that runoff events within the first 72 hours of application were the most important in terms of increases in detectible pesticide concentrations. Effectiveness monitoring of protective measures and limitations in the proposed action would target those periods of precipitation that could result in field surface runoff and increased streamflow. These periods are most likely to carry the greatest detectible concentrations of chemicals. If a runoff event occurs after spring applications, these events will be sampled.

Previous rates of surface runoff and predicted concentrations from aerial applications of esfenvalerate at the BLM - Horning Seed Orchard in the Salem District have been shown to be significantly lower than the literature and model predictions for the soils and climate at that orchard (BLM 2002). Under this Provolt and Sprague monitoring plan, similar investigation for ground-based applications of pesticides would be conducted at both orchards. Continuous flow recording stations would be established to collect water and sediment samples on a flow-weighted basis with the intention of providing individual storm concentrations for multiple runoff events. The data from recording stations would represent water quality conditions as a result of the effectiveness of implemented protection measures and limitations in the higher-risk seed production orchards.

All data would be used in conjunction with continuous recorded climate data to evaluate the effectiveness of protection measures and limitations in minimizing introduction of pesticides and fertilizers to the aquatic system. Samples would be analyzed at a state-certified laboratory that has detection limits of 0.02 ppb for most of the potential pesticides. Samples would be collected in accordance with laboratory instructions.

Subsurface Runoff

Subsurface flow could be a significant pathway for water to reach a stream system via the orchard units. Buffers exit between orchard units and adjacent open water, such as Williams Creek, the Applegate River, and irrigation ditches at Provolt; and Lake CASSO and a few intermittent streams at Sprague. Monitoring would provide an indication of the buffer area effectiveness and over time would provide information for future pesticide applications with the use of buffer areas.

Cumulative Effects Runoff

Even with non-detectible chemical concentrations, there is a potential for concentrations over a cumulative period to approach sublethal levels affecting beneficial uses. There

is also concern over the transitory nature of concentrations in the stormflow period and questions on whether sampling would account for concentration which may be present. Stormflow with the highest potential for chemical presence would be sampled and, during these flow events, samples would often be composited according to the rise and fall of the hydrograph, which in turn can inadvertently diminish concentrations.

In an effort to address these issues and answer the cumulative effects question, semi-permeable membrane devices (SPMDs) may be deployed, if applicable, to monitor the accumulation of chemicals in waters containing aquatic species. The SPMD is an in-stream "accumulator" which allows calculation of an average chemical concentration during the period of deployment. For this reason, the SPMDs would only be deployed during the initial winter storms and spring storm periods after pesticide application.

Stream flow gauges (USGS and BLM) would be maintained to provide flow data for deriving concentrations (chemical loading) over the period of time the SPMD is deployed. Data from the SPMD concentrations would be used to compare and validate the storm flow concentration monitored during the deployment period.

B.1.5.3 Validation Monitoring

Validation monitoring is intended to verify the water quality modeling predictions presented in the EIS. Concentrations well below those that would cause sublethal effects to fish were predicted for Williams Creek, Applegate River, and irrigation ditches at Provolt, and Jump-off Joe Creek near Sprague; and for all fertilizer applications under expected (typical) ground saturation conditions at the time of application. Monitoring the stream systems would identify the effectiveness of protection measures, and to help validate the conservative estimates in the risk assessment.

Collection chambers may be installed in areas where there are concerns regarding overland flow. During the first overland flow event following select chemical applications, these sites would be visited, and a water sample taken from the collection chamber. Once the first surface runoff event is captured and results become available, the need to sample later runoff events would be determined based on concentrations detected. In the short term, these data would be used to assess the mobility of chemicals with high aquatic toxicity. Concentrations would be compared with modeled results utilizing field- and climate-specific data to validate risk assessment estimates.

Stream concentrations would also be compared to model results using actual application information, field-specific data, and continuous climate record. These data would provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period would be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations would be "diluted" using the continuous flow data from the station. The resulting concentrations would be compared with the actual measured concentrations for each storm event sampled.

B.1.5.4 Compliance Monitoring

Spill Monitoring

In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, would be evaluated to determine if water sampling is desirable and necessary. If so, water samples may be collected in a sufficient number and at surface water and groundwater locations that would allow characterization of impacts and effective remediation methods. Depending on ODEQ Monitoring Hazardous Substances Remediation Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil. At a minimum, sampling would be

conducted in the streams draining the spill area and the immediate groundwater table. The orchard domestic well would be sampled if in proximity to spill.

A spill prevention plan would be developed prior to any pesticide applications, and be part of the Orchards Pesticide Safety Plan. The Spill Prevention Plan would minimize or eliminate the risk of a pesticide spill for any pesticide operation. The orchards would develop a model or general pesticide spill plan which would address concerns and identify such factors as: (1) critical sites where spills would likely occur, such as narrow road or stream/waterway crossings, soft soil or roadway areas, and rough roads; (2) mechanical or operational requirements, such as tire tread to reduce blowouts, speed limits at critical roadway curves or other areas, and quantity carrying capacity of tanks/vehicles at safe levels to prevent roll-overs and sloshing; (3) environmental restrictions such as rainfall limits and standing water limits; and (4) approved mixing sites.

At the operational level, the plan would include specific routes of the equipment, load limits for equipment, allowable speeds on the routes, mixing site limits in quantities, chemical types, or spill potential.

Groundwater Monitoring

The domestic and irrigation wells would be monitored according to the parameters outlined by the Oregon Department of Health. There are four monitoring wells and three irrigation/domestic wells at Sprague. Two irrigation/domestic wells and one proposed test well (2004) at Provolt are available for monitoring tests. A water sample could be taken from the wells on a yearly basis during maximum well usage for pesticide tests. The pesticide chosen would vary according to the rates, persistence, and mobility of the pesticides applied during the period since the last sampling. These samples would normally be collected in late summer and handled according to state-certified laboratory instructions.

B.1.6 Annual Reporting

All water quality monitoring information associated with application of the Sprague and Provolt Seed Orchards IPM program would be compiled, analyzed, documented, and reviewed on a "water year" basis. This "water year" would include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, would be contained in an Annual Provolt and Sprague Seed Orchards Monitoring Report. This report would be available to the public and regulatory agencies on November 15 of each year and be on file at the Provolt and Sprague Seed Orchards. BLM will request that NOAA Fisheries' review of this Plan be complete by January 15 of the following year. This schedule should provide for timely inclusion of monitoring results in the Annual Operating Report and inclusion of the full period of runoff during the fall/winter period and planning for the upcoming budget year.

B.1.7 Responsibility

Specific aspects of implementing this plan would be determined by the seed orchards orchardist with help and guidance from district hydrologists in coordination with the seed orchard program manager, tailoring the site-specific monitoring needs to the chemicals actually applied, the level of use, the risk of entering water, and the toxicity. At a minimum, water quality monitoring would be implemented to satisfy the terms and conditions of the NOAA Biologic Opinion. The orchardist, with review by a hydrologist, would be responsible for completing the "water quality monitoring component" of the Annual Sprague/Provolt Seed Orchards Monitoring Report for inclusion in the Annual Operation Report with the seed orchard manager for presenting results to the regulatory

agencies. The orchardists and district hydrologists would be responsible for formalizing future water sampling plans with the seed orchard program manager, selecting the sample locations and times, determining the methods for analyzing sample results, and submitting an annual budget.

The orchardist or hydrology specialists would be responsible for maintaining all sampling sites, collection of all water samples, quality assurance, quality control, shipment of samples to the laboratory, coordination with the analysis lab, and providing data for analysis.

B.2 Pest Monitoring

Monitoring of all pests (insects, diseases, vegetation, animals) and pest activities is an integral and continuing segment of the orchard IPM program on all lands in the orchards. A wide variety of monitoring tools is used to detect and report the incidence and severity of pest activity and damage to orchard resources and facilities.

Knowledge of the potential pests, past occurrence, and damage in the orchards or surrounding lands, recognition of damage symptoms, the analysis of the damage in relation to objectives, and other factors all help to determine the best route through an IPM program. Field observations and pest identification methods, plus specific pest and damage survey techniques, are used to detect the presence of pests and the severity of the damage. Annual assessments of cone and seed insect populations and damage are used to predict potential crop damage, the need for pest control, and the methods of pest management. Other insect, disease, vegetation (noxious weeds and competing vegetation), and animal pests are routinely surveyed throughout the orchard during normal orchard activities and projects, and during regular orchard tree inventories.

Pest and damage survey data are collected and summarized, then evaluated to determine the best methods of control if control measures are needed and the most effective methods of control. The primary focus of pest management in the orchards is the protection of cone and seed crops. Specific cone and seed insect monitoring plans for annual assessments would be developed or expanded to recognize present or new pests causing damage to cone crops or crop trees. Monitoring plans and techniques would be modified to incorporate new research. Orchard staff receive periodic training to build a knowledge base for recognition of orchard pests and damage symptoms. Forest health (insect and disease) specialists are contacted for identification and assessment support, and collaboration when necessary with the orchard manager for control decisions. In other IPM work, noxious weed specialists, botanists, wildlife biologists, fish biologists, and silviculturists may be contacted for expertise in identification of pests or control methods.

Douglas-fir cone gall midge monitoring has been done using pheromones to lure male gall midges to a sticky trap, and the collective data used to determine emergence and potential damage. Other field and lab monitoring methods such as cone dissection, seed x-rays, seed yields, and a variety of structured observations of insects and damage are used before and after control.

Monitoring pest control measures, particularly chemical applications, would include plans for monitoring the implementation of control projects, methods to determine the effectiveness of the protective measures used during the project implementation, validation monitoring to verify the modeling predictions in the EIS, and any necessary compliance monitoring.

B.3 Human Health Monitoring

All BLM employees involved in orchard pesticide application programs at Provolt and Sprague would be required to participate in a monitoring program. Monitoring would ensure that all of the worker protection measures and limitations to protect worker health are implemented during application projects. Documentation would include a written record of names and application duties of involved individuals, chemical(s) used, dates of application, acreage and location of treatment areas, use of protective clothing and equipment, duration of exposure, and method of application.

Baseline medical evaluations would be conducted on BLM employees for the use of cholinesterase-inhibiting pesticides. The Government would not conduct medical or personal monitoring of Contractors involved with pesticide application.

References

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Appendix C: Risk Assessment Summary

C.1 Risks to Human Health

Quantitative risk assessments were conducted to estimate the risks to members of the public and workers as a result of using the proposed pesticides and fertilizers at Provolt and Sprague Seed Orchards, as described under Alternative A, Maximum Seed Production. The application details are listed in Table 2.2-1 in Chapter 2 of this EIS, and the proposed application methods are described in an attachment to this appendix. The supporting record for this EIS contains the full risk assessments. The methodology and results of the human health risk assessment are summarized in the following paragraphs. Detailed information on inputs, methodology, assumptions, and outputs can be found in Sections 4.0, 5.0, and 6.0 of the risk assessment reports.

Computerized fate and transport modeling was conducted to estimate concentrations of pesticides in environmental media at the point of exposure. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was used to characterize the leaching and runoff behavior of the pesticides. Published studies and the Method of Characteristics model were used to represent attenuation in runoff due to buffer zones, and to estimate concentrations in groundwater and surface water. AgDRIFT was used to estimate off-target pesticide drift from applications using a tractor-pulled spray rig with a boom. Field studies reported in the published literature provided the basis for estimates of drift from other ground-based pesticide application methods. The Exposure Analysis Modeling System model was used to predict downstream concentrations following accidental spills of pesticide concentrate or tank mixes. Section 3.0 of the risk assessment reports provides an overview of the models, their inputs, and the results obtained. The estimated surface water concentrations due to runoff are presented in Tables C-1 and C-2 for Provolt and Sprague, respectively, and the estimated groundwater concentrations due to leaching are provided in Tables C-3 and C-4. Estimated drift deposition results are presented in Tables C-5 and C-6.

To assess the risk of human health effects from using pesticides and fertilizers at Provolt and Sprague, it was necessary to estimate the human exposures that could occur as a result of the proposed applications and associated activities, and to estimate the probability and extent of adverse health effects that could occur as a result of those exposures. This risk assessment employs the three principal analytical elements that the National Research Council (1983) described and EPA (1989, 2000a) affirmed as necessary for characterizing the potential adverse health effects of human exposures to existing or introduced hazards in the environment: hazard assessment, exposure assessment, and risk characterization.

The risk assessment addresses risks from fertilizers and the 14 pesticide active ingredients, as well as "other" ingredients in the pesticide formulations, formerly termed "inert" ingredients. EPA (2000b) has classified these other ingredients into four categories, based on the degree of toxicity posed by the chemical, as follows:

- List 1: Inerts of toxicological concern.
- List 2: Potentially toxic inerts, with high priority for testing
- List 3: Inerts of unknown toxicity
- List 4: Inerts of minimal concern

To include consideration of potential risks from these chemicals, any "other" ingredients in the proposed pesticide formulations that appear on either List 1 or List 2 are included

Table C-1. Provolt: Estimated Surface Water Concentrations from Runoff and Erosion (mg/L)

		Ditch Segments		Williams Creek		Applegate River		Pond	
Chemical	**App Method**	**Typ**	**Max**	**Typ**	**Max**	**Typ**	**Max**	**Typ**	**Max**
Chlorpyrifos	HPHS & HHW	-0-	4.87E-008	-0-	6.20E-009	-0-	2.41E-009	-0-	4.87E-009
Diazinon	HPHS & HHW	-0-	2.92E-009	-0-	3.25E-009	-0-	2.12E-010	-0-	2.92E-010
Dimethoate	HHW & BP	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Cyclohexanone		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Petroleum distillate		-0-	7.38E-009	-0-	8.00E-009	-0-	3.11E-009	-0-	-0-
Esfenvalerate	HPHS	-0-	2.48E-009	-0-	7.93E-010	-0-	1.22E-009	-0-	-0-
Ethylbenzene		-0-	-0-	-0-	-0-	-0-	8.72E-013	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Esfenvalerate	HHW & BP	-0-	9.25E-010	-0-	1.00E-009	-0-	3.90E-010	-0-	-0-
Ethylbenzene		-0-	3.03E-011	-0-	5.37E-011	-0-	3.49E-012	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Horticultural Oil	HPHS	-0-	-0-	-0-	-0-	-0-	5.68E-010	-0-	-0-
Permethrin	HPHS	-0-	2.10E-009	-0-	6.69E-010	-0-	1.16E-009	-0-	-0-
Ethylbenzene		-0-	-0-	-0-	-0-	-0-	3.87E-012	-0-	-0-
Light aromatic solvent naphtha		-0-	5.22E-009	-0-	1.67E-009	-0-	3.04E-009	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Permethrin	HHW & BP	-0-	1.62E-011	-0-	1.75E-011	-0-	6.82E-012	-0-	-0-
Ethylbenzene		-0-	1.81E-011	-0-	3.21E-011	-0-	2.09E-012	-0-	-0-
Light aromatic solvent naphtha		-0-	3.67E-010	-0-	3.98E-010	-0-	1.55E-010	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Propargite	HPHS, HHW, & BP	-0-	1.77E-008	-0-	4.46E-009	-0-	7.45E-009	-0-	-0-
Chlorothalonil	HPHS & HHW	-0-	8.17E-009	-0-	6.57E-009	-0-	3.45E-009	-0-	-0-
Dicamba	HHW, BP, Boom, Wick	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate	HHW & BP	-0-	5.82E-010	-0-	6.31E-010	-0-	2.46E-010	-0-	-0-
Glyphosate	Boom & Wick	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Hexazinone	HHW & BP	-0-	8.93E-012	-0-	1.58E-011	-0-	1.03E-012	-0-	-0-
Picloram	HHW & BP	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Hexachlorobenzene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Triclopyr butoxyethyl ester	HHW & BP	-0-	3.30E-010	-0-	3.58E-010	-0-	1.39E-010	-0-	-0-
Total Fertilizer	Spreader								
NO3 (as N)		-0-	6.52E-004	-0-	7.03E-005	-0-	3.32E-005	-0-	6.52E-005
NH4 (as N)		-0-	4.08E-008	-0-	6.11E-008	-0-	2.47E-009	-0-	4.08E-009
PO4 (as P2O5)		-0-	5.24E-007	-0-	5.74E-008	-0-	2.91E-008	-0-	5.24E-008

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-2. Sprague: Estimated Surface Water Concentrations from Runoff and Erosion (mg/L)

Chemical	App Method*	Stream Segments		Main Tributary		Jump-Off Joe Creek		Lake Casso	
		Typ	Max	Typ	Max	Typ	Max	Typ	Max
Chlorpyrifos	HPHS & HHW	3.08E-007	6.67E-006	2.52E-008	5.46E-007	3.97E-010	8.96E-009	-0-	-0-
Diazinon	HPHS & HHW	-0-	9.39E-007	-0-	7.68E-008	-0-	1.25E-009	-0-	-0-
Dimethoate	HHW & BP	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Cyclohexanone		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Petroleum distillate		1.51E-006	1.47E-005	1.36E-007	1.32E-006	2.06E-009	2.18E-008	-0-	-0-
Esfenvalerate	HPHS	6.17E-007	6.73E-007	2.03E-008	2.22E-008	1.76E-009	2.31E-009	3.76E-010	4.10E-010
Ethylbenzene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Esfenvalerate	HHW & BP	2.53E-007	8.41E-007	2.28E-008	7.57E-008	3.46E-010	1.24E-009	-0-	-0-
Ethylbenzene		-0-	1.40E-008	-0-	1.26E-009	-0-	2.05E-011	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Horticultural Oil	HPHS	4.00E-006	1.26E-005	2.68E-007	8.45E-007	4.07E-009	1.39E-008	-0-	-0-
Horticultural Oil	HHW & BP	9.92E-007	5.63E-006	8.93E-008	5.07E-007	1.35E-009	8.33E-009	-0-	-0-
Permethrin	HPHS	9.26E-008	1.30E-007	3.03E-009	4.27E-009	2.03E-010	4.47E-010	-0-	-0-
Ethylbenzene		-0-	1.29E-008	-0-	4.25E-010	-0-	4.33E-011	-0-	7.86E-012
Light aromatic solvent naphtha		6.89E-007	3.34E-006	2.27E-008	1.10E-007	1.96E-009	1.15E-008	4.21E-010	2.04E-009
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Permethrin	HHW & BP	8.33E-009	4.50E-008	7.50E-010	4.05E-009	1.00E-011	6.66E-011	-0-	-0-
Ethylbenzene		-0-	1.40E-008	-0-	1.26E-009	-0-	2.06E-011	-0-	-0-
Light aromatic solvent naphtha		5.77E-008	1.07E-006	5.19E-009	9.66E-008	7.88E-011	1.59E-009	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Propargite	HPHS, HHW, & BP	1.35E-009	1.76E-008	8.01E-010	1.04E-008	1.22E-011	1.71E-010	1.70E-009	2.22E-008
Chlorothalonil	HPHS	3.48E-009	5.43E-008	2.07E-009	3.23E-008	3.14E-011	5.30E-010	4.40E-009	6.86E-008
Dicamba	HHW, BP, Boom, Wick	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate	HHW & BP	5.82E-007	8.55E-006	1.18E-007	1.73E-006	1.80E-009	2.84E-008	-0-	-0-
Glyphosate	Boom & Wick	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Hexazinone	HHW & BP	-0-	5.71E-009	-0-	1.15E-009	-0-	1.88E-011	-0-	-0-
Picloram	HHW & BP	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Hexachlorobenzene		-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Triclopyr butoxyethyl ester	HHW & BP	1.03E-007	6.58E-006	2.09E-008	1.33E-006	3.17E-010	2.18E-008	-0-	-0-
Total Fertilizer	Spreader								
NO3 (as N)		2.67E-002	3.20E-002	3.79E-003	4.27E-003	9.57E-005	9.27E-005	1.09E-004	1.21E-004
NH4 (as N)		-0-	6.00E-001	-0-	9.29E-002	-0-	2.30E-003	-0-	9.34E-003
PO4 (as P2O5)		4.71E-005	9.99E-003	6.85E-006	1.38E-003	1.63E-007	3.14E-005	1.96E-007	3.93E-005

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-3. Provolt: Estimated Groundwater Concentrations (mg/L)

Chemical	Method	Estimated Groundwater Concentration (mg/L) Typ	Max
Chlorpyrifos	HPHS & HHW	-0-	-0-
Diazinon	HPHS & HHW	-0-	-0-
Dimethoate	HHW & BP	-0-	1.3E-008
Cyclohexanone		-0-	-0-
Petroleum distillate		-0-	-0-
Esfenvalerate	HPHS, HHW, & BP	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Horticultural Oil	HPHS, HHW, & BP	-0-	-0-
Permethrin	HPHS, HHW, & BP	-0-	-0-
Ethylbenzene		-0-	-0-
Light aromatic solvent naphtha		-0-	-0-
Xylene		-0-	-0-
Propargite	HPHS, HHW, & BP	-0-	-0-
Chlorothalonil	HPHS	-0-	-0-
Dicamba	HHW, BP, Boom, & Wick	-0-	-0-
Glyphosate	HHW, BP, Boom, & Wick	-0-	-0-
Hexazinone	HHW & BP	-0-	5.9E-009
Picloram	HHW & BP	-0-	5.9E-013
Triclopyr butoxyethyl ester	HHW & BP	-0-	-0-
Total Fertilizer	Spreader		
NO3 (as N)		-0-	-0-
NH4 (as N)		-0-	-0-
PO4 (as P2O5)		1.20E-004	1.20E-004

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-4. Sprague: Estimated Groundwater Concentrations (mg/L)

Chemical	App Method*	Estimated Groundwater Concentration (mg/L) Typ	Max
Chlorpyrifos	HPHS & HHW	-0-	-0-
Diazinon	HPHS & HHW	-0-	-0-
Dimethoate	HHW & BP	5.09E-008	3.63E-005
Cyclohexanone		-0-	-0-
Petroleum distillate		-0-	-0-
Esfenvalerate	HPHS, HHW, & BP	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Horticultural Oil	HPHS, HHW, & BP	-0-	-0-
Permethrin	HPHS, HHW, & BP	-0-	-0-
Ethylbenzene		-0-	-0-
Light aromatic solvent naphtha		-0-	-0-
Xylene		-0-	-0-
Propargite	HPHS, HHW, & BP	-0-	-0-
Chlorothalonil	HPHS	-0-	-0-
Dicamba	HHW, BP, Boom, & Wick	-0-	-0-
Glyphosate	HHW, BP, Boom, & Wick	-0-	-0-
Hexazinone	HHW	1.86E-004	1.34E-003
Hexazinone	Backpack	3.35E-004	1.34E-003
Picloram	HHW & BP	8.18E-005	6.32E-004
Triclopyr butoxyethyl ester	HHW & BP	-0-	-0-
Total Fertilizer	Spreader		
NO3 (as N)		2.13E-003	1.80E-003
NH4 (as N)		-0-	-0-
PO4 (as P2O5)		3.44E-003	3.44E-003

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-5. Provolt: Estimated Drift Deposition from Boom Applications

Pesticide	Concentration (mg/L)						Deposition at 25 Feet (lb/acre)
	Ditch			Williams Creek			
	Typ	Max		Typ	Max		Typ[b]
Dicamba	5.17E-04	1.11E-06		6.73E-08	1.73E-07		1.11E-02
Glyphosate	5.17E-07	2.22E-06		6.73E-08	3.47E-07		1.11E-02

a24-hour average concentrations.
bDrift at 25 feet is only required for evaluating typical scenarios in this assessment.

Table C-6. Sprague: Estimated Drift Deposition from Boom Applications

Pesticide	Stream Concentration (mg/L)[a]		Deposition at 25 Feet (lb/acre)
	Typ	Max	Typ[b]
Dicamba	5.34×10^{-4}	1.55×10^{-3}	0.0111
Glyphosate	8.01×10^{-4}	3.87×10^{-3}	0.0111

a24-hour average concentrations.
bDrift at 25 feet is only required for evaluating typical scenarios in this assessment.

in this quantitative risk assessment, along with the active ingredient in the formulation. Accordingly, the following "other" ingredients are included in the human health (and non-target species) risk assessments:

- Cyclohexanone: present in Digon® 400 formulation of dimethoate.
- Ethylbenzene: present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin.
- Light aromatic solvent naphtha: present in the Pounce® 3.2 EC formulation of permethrin.
- Petroleum distillates: present in the Digon® 400 formulation of dimethoate.
- Xylene: present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin.

C.1.1 Human Health Hazard Assessment

Methodology and Data Summary

Hazard assessment requires gathering information to determine the toxic properties of each chemical and its dose-response relationship. Human hazard levels are derived primarily from the results of laboratory studies on animals. The goal of the hazard assessment is to identify acceptable doses for noncarcinogens, and identify the cancer potency of potential carcinogens.

For noncarcinogenic effects, it is generally assumed that there is a threshold level, and that doses lower than this threshold can be tolerated with little potential for adverse health effects. EPA has determined threshold doses for many chemicals; these are

referred to as reference doses (RfDs). The oral RfD is an estimate of the highest possible daily oral dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime. The uncertainty of the estimate usually spans about one order of magnitude.

EPA selects the RfD using the lowest no-observed-effect level (NOEL) from the species and study most relevant to humans. (The NOEL is the dose in a toxicity study at which there is no statistically or biological significant increase in the frequency or severity of an adverse effect in individuals in an exposed group, when compared with individuals in an appropriate control group.) In the absence of data from the most clearly relevant species, a study using the most sensitive species (the species that exhibited the lowest NOEL) is selected for use in RfD determination. This NOEL is divided by an uncertainty factor (usually 100) consisting of a factor of 10 to allow for the variation of response within the human population and a factor of 10 to allow for extrapolation to humans. Additional uncertainty factors may be applied to account for extrapolation from a shorter term study, overall inadequacy of data, or failure to determine a no-effect level. RfDs are expressed in units of mg/kg/day.

In many cases, exposures to the chemicals proposed for use at Provolt and Sprague will not occur every day for a person's lifetime, but over a shorter duration. EPA's Risk Assessment Guidance for Superfund (EPA 1989) discusses the use of subchronic RfDs when exposures may range from two weeks to seven years in duration, instead of an individual's entire lifetime. These subchronic RfDs are *not* used in the assessment of risks from seed orchard chemicals, for the following reasons:

- The seed orchard pesticide and fertilizer use programs are anticipated to be in effect for more than seven years, exceeding the upper time limit for exposure in EPA's discussion of appropriate use of subchronic RfDs. It is safe to assume that length of employment and length of residence may make the exposure scenarios applicable to an individual worker or nearby resident for longer than a seven-year period.
- EPA (2000c) stated that subchronic RfDs should not be used to evaluate risks to children, as they may not be sufficiently protective. Children are a subset of the general public whose risks are assessed in the analysis.

Additionally, the use of chronic RfDs provides a more conservative estimate of the dose-response relationship in all cases, decreasing the likelihood of underestimating any potential risks to any worker or member of the public.

Data on carcinogenic potential were reviewed for each chemical. Acephate, permethrin, and propargite are considered possible human carcinogens; and chlorothalonil and hexachlorobenzene (a contaminant in picloram) are considered to be probable human carcinogens. For these compounds, cancer slope factors that have been calculated by EPA or other appropriate sources are used in this risk assessment. The cancer slope factor of a chemical represents the probability that a 1-mg/kg/day chronic dose will result in formation of a tumor, and is expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

The RfDs and cancer slope factors used in this risk assessment are summarized in Table 4.6-1 in Chapter 4 of this EIS.

Data Availability and Quality

A consistent level of information on all data points researched was not available for all of the chemicals evaluated in this risk assessment. For the endpoints evaluated in this quantitative risk assessment, there are no data gaps in the information available for acephate, chlorothalonil, chlorpyrifos, diazinon, dimethoate, esfenvalerate, glyphosate,

permethrin, picloram, and propargite. However, the following data gaps were identified and addressed as described:

- No studies of dermal absorption were available for dicamba. USDA (1984) recommended a value of 10% as a conservative assumption. This value is used in the risk assessment.

- Hexazinone's carcinogenic potential is unknown, with equivocal results from one study in mice and negative results from a study in rats. Cancer risks are not quantified for this pesticide.

- Conclusive information was not available on triclopyr's potential for carcinogenicity. Therefore, no judgment was made as to whether it is potentially carcinogenic, and no quantitative cancer risk analysis was conducted.

- No dermal absorption factor was identified for cyclohexanone. A value of 10% was selected for use in the risk assessment. Carcinogenicity findings for cyclohexanone were inconclusive. No quantitative analysis of the compound's cancer risk is conducted.

- Inhalation studies of ethylbenzene in rats and mice resulted in some tumors in the high-exposure groups, although EPA lists it as not classifiable as to human carcinogenicity. No cancer risk assessment is conducted for this chemical.

- Although naphthalene (an example of the "other" ingredient light aromatic solvent naphtha) is considered a possible human carcinogen, the available data do not allow calculation of a cancer slope factor; therefore, no quantitative estimate of cancer risk from light aromatic solvent naphtha compounds is made. No dermal absorption data were available, so a default value of 10% was selected for use in the risk assessment.

- For xylene, one negative and one equivocal carcinogenicity study were reported, and dermal studies have indicated a potential for xylene to be a promoter or co-carcinogen for skin cancer. Due to the lack of conclusive information, no judgment was made in this risk assessment as to whether xylene is potentially carcinogenic, and no quantitative cancer risk analysis was conducted for it.

- No dermal absorption data were available for the fertilizers. A value of 1% was used in the risk assessment.

C.1.2 Human Health Exposure Assessment

Exposure assessment involves estimating doses to persons potentially exposed to the pesticides or fertilizers. In the exposure assessment, dose estimates were made for typical, maximum, and accidental exposures. These exposures are defined as follows:

- *Typical:* For this risk assessment, the word "typical" refers to a level of exposure within a scenario, and does not indicate whether the scenario itself is likely to occur. Typical exposure reflects the average dose an individual may receive if all exposure conditions are met. Typical exposure assumptions include the application rate usually used at the seed orchards, usual number of applications per year, the average of the ten highest values for chemical concentrations predicted to be present in runoff over a 10-year period of annual typical applications, and other similar assumptions.

- *Maximum:* Maximum exposure defines the upper bound of credible doses that an individual may receive if all exposure conditions are met. Maximum exposure assumptions include the maximum application rate according to the label, maximum number of applications per year, the highest chemical concentration predicted to be

present in runoff over a 10-year period of annual maximum applications, and other similar assumptions.

- *Accidental:* The possibility of error exists with all human activities. Therefore, it is possible that during seed orchard operations, accidents could expose individuals to unusually high levels of pesticides or fertilizers. To examine these potential health effects, several accident scenarios were evaluated for health effects to members of the public and workers.

It is important to note that these exposure scenarios estimate risks from clearly defined types of exposure. If all the assumptions in an exposure scenario are not met, the dose will differ from that estimated here, or may not occur at all.

For members of the public, the exposure scenarios analyzed in this risk assessment consist of the following:

- Ingestion of groundwater.
- Ingestion of water from Applegate River or Williams Creek at Provolt; or from the intermittent stream draining the northwest section of Sprague at the point where two main eastern branches converge south of Orchard Unit ARB3. None of these are known sources of drinking water for local residents.
- Ingestion of fish from Applegate River, Williams Creek, or the pond near the seed orchard office at Provolt; or from Jump-off Joe Creek or the onsite pond (Lake CASSO) at Sprague.
- Ingestion of deer and quail hunted near orchard lands.
- Ingestion of Canada goose hunted near orchard lands (Provolt only).
- Ingestion of blackberries.
- Dermal exposure to insecticide/fungicide drift residues on vegetation, or herbicide treatment residues on vegetation, during recreational hiking on orchard lands.
- Dermal exposure to residues on dogs following recreational use of site.

The categories of workers evaluated in this risk assessment for occupational exposure to pesticides are as follows:

- High-pressure hydraulic sprayer mixer/loader/applicator.
- Hydraulic sprayer with hand-held wand mixer/loader/applicator.
- Tractor-pulled spray rig with boom mixer/loader/applicator.
- Backpack sprayer mixer/loader/applicator.
- Hand-held wick mixer/loader/applicator.
- Broadcast fertilizer spreader loader/applicator.
- Irrigation system maintenance personnel.

Several accidental exposure scenarios were also evaluated:

- Ingestion of groundwater after a spill of concentrate.
- Ingestion of fish and water containing runoff from a spill of concentrate.
- Ingestion of fish and water downstream of a spill of tank mix directly into a stream.
- Spill of pesticide concentrate onto worker's skin.
- Spill of pesticide mixture onto worker's skin.
- Spray of worker with tank mix of pesticide.

C.1.3 Human Health Risk Characterization

Methodology

Risk characterization requires comparing the hazard information with the dose estimates to predict the potential for health effects to individuals under the conditions of exposure. The risk characterization also identifies uncertainties (such as data gaps where scientific studies are unavailable) that may affect the magnitude of the estimated risks.

In this risk assessment, the potential noncarcinogenic risks were evaluated by comparing the representative doses (estimated in the exposure assessment) with the RfDs (identified in the hazard assessment). All the RfDs used in this risk analysis take into account multiple exposures over several years and represent acceptable dose levels. The comparison of dose to RfD consists of a simple ratio, called the hazard index:

Hazard Index = Estimated Dose (mg/kg/day) ÷ RfD (mg/kg/day)

If the estimated dose does not exceed the RfD, the hazard index will be one or less, indicating a negligible risk of noncarcinogenic human health effects.

A dose estimate that exceeds the RfD, although not necessarily leading to the conclusion that there will be toxic effects, clearly indicates a potential risk for adverse health effects. Risk is presumed to exist if the hazard index is greater than one. However, comparing one-time or once-a-year doses (such as those experienced by the public or in an accident) to RfDs derived from long-term studies with daily dosing tends to exaggerate the risk from those infrequent events.

For workers and the public, hazard indices were computed for each chemical, application, and scenario for typical, maximum, and accident situations. For pesticide formulations containing ingredients on EPA's List 1 or 2 of "other" ingredients, the hazard indices for each component of the formulation are added together, to indicate the total risk to the exposed individual from that pesticide.

If the hazard index exceeds one, the risk may require mitigation, depending on the circumstances of exposure. For workers, this may mean reducing the quantity of pesticide to which the worker is exposed or increasing the level of protective clothing. For members of the public, it may mean decreasing the application rate or using measures to reduce the potential for runoff to reach streams. In some cases, the simple mitigation procedures will not reduce exposures (and thereby decrease the hazard index) to an acceptable level. In these cases, the seed orchard manager may consider use of a different pesticide or use a non-pesticide method to meet management goals.

To estimate cancer risk, the dose is averaged over a lifetime (75 years), and multiplied by the chemical's cancer slope factor. The resulting cancer probability is compared to a benchmark value of one in one million, a value commonly accepted in the scientific community as representing a cancer risk that would result in a negligible addition to the background cancer risk of approximately one in four in the U.S.

Risk Summary

Hazard indices and cancer risks for each chemical and scenario are presented in tables in Section 6.0 of the risk assessment reports. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.6-2 in Chapter 4 of this EIS.

Members of the Public

For members of the public, hazard indices were less than one for all typical and maximum exposure scenarios, and cancer risks were all less than 1×10^{-6} (one in one million), ranging up to 8.98×10^{-10} (8.98 in ten billion) at Provolt and 2.98×10^{-10} (2.98 in ten billion) at Sprague.

There is a block of private property outside the eastern border of Provolt. Risks from seed orchard pesticide drift to users of these properties would be no greater than risks from the drift calculations that were applied to recreational hikers or blackberry harvesters, which do not exceed the levels of concern. That is, all hazard indices are less than one and all cancer risks are less than one in one million for these scenarios.

Workers

For typical scenarios, worker hazard indices are less than one, with the following exceptions:

- A hydraulic sprayer with hand-held wand mixer/loader/applicator applying dimethoate, and
- A backpack sprayer applying dimethoate, permethrin, propargite, or dicamba.

In the maximum scenarios, the hazard indices exceed one for the following workers:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon;
- A hydraulic sprayer with hand-held wand mixer/loader/applicator applying diazinon (Provolt only) or dimethoate;
- A backpack sprayer applying dimethoate, permethrin, propargite, dicamba, or hexazinone; and
- An irrigation system maintenance worker encountering residues of chlorpyrifos or diazinon.

The estimated cancer risk to backpack sprayers applying propargite is 2.54 in 100,000 at Provolt and 1.74 in 100,000 at Sprague, in both cases exceeding the standard point of departure of one in one million. All other cancer risks to workers were less than one in one million.

Risk Management Approaches

If applications of these pesticides were prescribed, risks to mixer/loader/applicators could be mitigated by decreasing the application rate, using water soluble bags (if available), spreading the work over a longer time period, increasing the use of personal protective equipment, and dividing the work between two or more workers. Risks to irrigation system maintenance workers could be mitigated by increasing the time period between applications and maintenance activities to allow additional degradation, decreasing the application rate, increasing the use of personal protective equipment, and dividing the work between two or more workers.

Accidents

For a spill of a container of pesticide concentrate or fertilizer at the mixing area, no risks to the public from drinking groundwater contaminated by leached chemical were predicted. If precipitation caused runoff of spill residues to surface water from the

spill site, risks were predicted from chlorpyrifos and diazinon to adults and children consuming fish or surface water from the Applegate River at Provolt, and from diazinon to children consuming fish or surface water from Jump-off Joe Creek at Sprague. All estimated cancer risks were less than one in one million.

At Provolt, for a spill of an application tankload of mixed pesticide into Bridge Point Ditch, risks to the public from drinking water and eating fish from the Applegate River are predicted for chlorpyrifos, diazinon, propargite, and chlorothalonil. All cancer risks are less than one in one million. For a spill of an application tankload of mixed pesticide into Williams Creek, risks to the public from drinking water and eating fish from the Applegate River are predicted for chlorpyrifos, diazinon, propargite, and chlorothalonil. All cancer risks are less than one in one million.

At Sprague, for a spill of an application tankload of mixed pesticide from the orchard road that crosses the Lake CASSO spillway, risks to the public from drinking water and eating fish from Jump-off Joe Creek are predicted for chlorpyrifos, diazinon, and chlorothalonil. All cancer risks are less than one in one million. For a spill of an application tankload of mixed pesticide from the orchard road crossing an intermittent stream near the southwest corner of Orchard Unit 53, risks to the public from drinking water and eating fish from Jump-off Joe Creek are predicted for chlorpyrifos, diazinon, and chlorothalonil. All cancer risks are less than one in one million.

In the accident scenario in which a worker spills liquid pesticide concentrate on the skin, hazard indices exceed one (ranging up to 10,100 for dimethoate) for handling acephate implants that were spilled on, and for dimethoate, esfenvalerate, permethrin, chlorothalonil, and dicamba. Estimated cancer risks were all less than one in one million.

In the accident scenario in which a worker spills tank-mixed diluted pesticide on the skin, hazard indices are greater than one for chlorpyrifos, diazinon, dimethoate, and dicamba. All estimated cancer risks are less than one in one million.

Hazard indices for the accident scenario in which a worker was directly sprayed exceed one for dimethoate. Estimated cancer risks are all less than one in one million.

Cumulative Human Health Risks

No data indicating synergistic toxicity exists among the proposed chemicals were identified. Therefore, cumulative human health risks were estimated assuming additive toxicity.

For members of the public, risks were aggregated from all routes of exposure for each chemical, as estimated for the typical scenarios. These chemical-specific aggregated risks were then added together to provide an upper bound estimate of the cumulative risk for adults and children. Actual cumulative risk values are likely to be far less than the results estimated in this assessment, since (1) it is highly unlikely that one individual would be exposed to every chemical in all of the scenarios evaluated in the risk assessment; (2) several pesticides are proposed for use as alternatives for certain groups of target pests or weeds, and if one was selected for use in a given season, the alternatives would not also be used; (3) where multiple application methods are possible for a proposed pesticide treatment scenario, the method with the highest associated risk was included in the cumulative assessment; and (4) the temporal spacing of the potential chemical applications would correspond to a timeline in which some exposure routes were no longer active due to dissipation and degradation, prior to application of other chemicals. The upper bound cumulative risk estimates are as follows:

- At Provolt, cumulative hazard indices are 0.0503 and 0.0718 for adult and child members of the public, respectively. At Sprague, the values are 0.0476 for adults and

0.0678 for children. These values do not exceed the reference value of one, at which noncarcinogenic hazard indices are concluded to represent a risk.

- At Provolt, cumulative cancer risks are 1.33×10^{-9} (1.33 in one billion) and 2.20×10^{-9} (2.20 in one billion) for adult and child members of the public, respectively. At Sprague, the risks are 4.39×10^{-10} for adults and 8.54×10^{-10} for children. None of these values exceeds the cancer risk criterion of one in one million.

For workers, the highest cumulative exposure could occur if one employee was involved in all pesticide applications. In this case, the cumulative hazard index for workers is 4,230 at Provolt and 2,120 at Sprague, and the cumulative cancer risk is 2.55 in 100 thousand at Provolt and 1.76 in 100,000 at Sprague. It is important to note that this cumulative risk scenario includes the unlikely case in which all pesticides that target every pest problem are called for during the season. The highest contributor to the cumulative hazard index is dimethoate (4,220 at Provolt, 2,110 at Sprague) for an individual applying the chemical by a backpack sprayer and conducting irrigation system maintenance activities. The estimated cumulative cancer risk to workers is 2.55×10^{-5} at Provolt and 1.76×10^{-5} at Sprague. The main contributor to this risk is propargite, which is associated with a 2.54×10^{-5} cancer risk at Provolt and a 1.74×10^{-5} cancer risk at Sprague for an individual conducting backpack application and irrigation system maintenance activities.

Uncertainties

The risks summarized in this assessment are not probabilistic estimates of risk, but are conditional estimates. That is, these risks are likely only if all exposure scenario assumptions that were described are met. In addition, the methodology applied to estimating risks is not definitive, since uncertainty in the final risk estimates is introduced in almost every step of the assessment. Some of the primary areas of uncertainty are as follows:

- The accuracy of the RfDs in approximating doses to humans that pose negligible risk of health effects, without either under- or overestimating these doses: the RfDs are derived from tests in laboratory animals. Extrapolating the results of animal tests to human health hazards has an inherent level of uncertainty associated with it.

- The use of the conservative approach, recommended by EPA, that chronic toxicity data be used in estimating risks from occasional (or, at most, subchronic) exposures to the chemicals proposed for use at the seed orchards.

- The cancer slope factors, in providing a good approximation of the chemical's carcinogenic potency in humans: updated guidelines for estimating cancer risks are in progress that may provide a different approach to estimating cancer risks for some of the chemicals evaluated in this report (see discussion in Section 6.2.2 of the risk assessment reports). However, reassessment of the carcinogenic mechanism and application of an appropriate strategy for cancer risk assessment for any one chemical may be years away. This analysis uses the cancer risk approach currently used by EPA for estimating the cancer potency of each chemical.

- The equations and studies on which the dose estimations are based: Many monitoring studies have been conducted since the 1970s that measure exposures to pesticides in a range of situations. This risk assessment relies on those that (1) are most relevant to the types of applications at the seed orchards, (2) incorporated sound methodology to provide a degree of confidence in the reported results, and (3) monitored, correlated, and reported a sufficient number of parameters to allow extrapolation to other situations.

All together, it is likely that the uncertainty in the risk estimates predicted in this assessment spans at least an order of magnitude. For example, for a hazard index estimated to be 0.0035, the true value is likely to be within the range of 0.035 to 0.00035, as a result of the uncertainties described here.

C.2 Risks to Non-Target Species

A quantitative non-target species risk assessment was conducted to evaluate the potential effects of the proposed chemical pesticides and fertilizers on terrestrial and aquatic wildlife species. The methodology and results are summarized in the following paragraphs; detailed information on inputs, methodology, assumptions, and outputs can be found in Sections 7.0, 8.0, and 9.0 of the risk assessment reports.

The results of computerized fate and transport modeling were used to estimate concentrations of chemicals at points of exposure for non-target species, just as described in the summary of the human health risk assessment. Details of the methods and models can be found in Section 3.0 of the risk assessment reports. Estimated surface water concentrations can be found in Tables C-1 and C-2 for runoff, and C-5 and C-6 for drift.

The non-target species risk assessment follows the steps of problem formulation, analysis, and risk characterization, as described in EPA's Guidelines for Ecological Risk Assessment (EPA 1998). This risk assessment also identifies uncertainties that are associated with the conclusions of the risk characterization. Risks to non-target species were evaluated for the fertilizers, pesticides, and List 1 or 2 "other" ingredients in the pesticide formulations.

C.2.1 Problem Formulation

In problem formulation, the purpose of the assessment is provided, the problem is defined, and a plan for analyzing and characterizing risk is determined. The potential stressors (in this case, pesticides and fertilizers), the ecological effects expected or observed, the receptors, and ecosystem(s) potentially affected are identified and characterized. Using this information, the three products of problem formulation are developed: (1) assessment endpoints that adequately reflect management goals and the ecosystem they represent, (2) conceptual models that describe key relationships between a stressor and assessment endpoint, and (3) an analysis plan that includes the design of the assessment, data needs, measures that will be use to evaluate risk hypotheses, and methods for conducting the analysis phase of the assessment.

The ecological effects that may be associated with the chemical pesticides and fertilizers are those associated with direct toxicity to non-target species that encounter the chemical. Permanent or persistent exposures through environmental pathways are not expected, since the half-lives of these chemicals are on the order of one month or less. Control of certain pests and vegetation in and of itself is not expected to affect the area's wildlife, since the seed orchards are managed areas, and have been managed for tree species preservation and seed production for 20 (Provolt) and 32 (Sprague) years.

The receptors in this non-target species risk assessment were selected to represent the range of species present at or near Provolt and Sprague, along with specific evaluation of special status species that may inhabit or visit the site. These receptors include mammals, birds, reptiles, amphibians, fish, and aquatic vertebrates for which quantitative risk estimates can be made. In addition, special status species were also identified and evaluated for potential risks.

Assessment endpoints are selected based on three criteria: ecological relevance, susceptibility to stressors, and relevance to management goals (EPA 1998). For special

status species, the assessment endpoint selected is individual survival, growth, and reproduction. For general species present at the seed orchards, the assessment endpoint selected is the survival of populations.

A conceptual model was developed to illustrate the relationships between stressors, exposure routes, and receptors. The conceptual model is presented in Figure 4.7-1 in Chapter 4 of this EIS.

Based on the conceptual model, an analysis plan was developed with the following components:

- Selection of typical and maximum exposure scenarios to evaluate risks to terrestrial and aquatic wildlife species;
- Identification of representative terrestrial and aquatic species and their characteristics, illustrating the various types of exposure that wildlife species may have to chemicals used at the seed orchards;
- Estimation of environmental exposures in terms of dose (mg/kg) for terrestrial species or concentration (mg/L) for aquatic species;
- Research and summary of the toxic properties of each pesticide, "other" ingredient, and fertilizer to wildlife species, to identify endpoints, including median lethal doses (LD_{50}s), median lethal concentrations (LC_{50}s), and maximum acceptable toxicant concentrations (MATCs); and
- Comparison of the doses and concentrations identified in the exposure characterization to the toxic properties identified in the effects characterization, using the guidelines specified by EPA's Office of Pesticide Programs for interpreting risk estimates to general wildlife and to special status species.

C.2.2 Analysis

Analysis is a process that examines the two primary components of risk–exposure and effects–and the relationships between each other and ecosystem characteristics. The assessment endpoints and conceptual models developed during problem formulation provide the focus and structure for the analysis. Exposure characterization describes potential or actual contact or co-occurrence of stressors with receptors, to produce a summary exposure profile that identifies the receptor, describes the exposure pathway, and describes the intensity and extent of contact or co-occurrence. Ecological effects characterization consists of evaluating ecological effects (e.g., ecotoxicity) data on the stressor of interest, as related to the assessment endpoints and the conceptual models, and preparing a stressor-response profile.

The terrestrial species exposure scenarios postulate that a variety of terrestrial wildlife species use the Provolt and Sprague Seed Orchards at various times. The scenarios further postulate that these terrestrial species may be exposed to any applied pesticides or fertilizers through ingestion of contaminated food and water and, in the maximum scenario, direct dermal spray as a result of being in an area while a treatment is occurring.

The list of representative terrestrial species is as follows:

<u>Mammals</u>
- Deer (large herbivore)
- Coyote (carnivore)
- Long-tailed vole (small herbivore) (Provolt only)

- Jack rabbit (small herbivore) (Sprague only)
- Pocket gopher (subterranean herbivore)
- Raccoon (omnivore)
- Long-eared myotis (insectivore)
- Dog (domestic)

Birds

- Black-capped chickadee (conifer seed-eater)
- Western bluebird (insectivore)
- Tree swallow (insect- and fruit-eater)
- Canada goose (herbivore)
- Mallard duck (water fowl)
- Great blue heron (Provolt only)
- Common barn owl (raptor) (Provolt only)
- Red-tailed hawk (raptor) (Sprague only)
- Osprey (piscivore) (Provolt only)
- Song sparrow (seed-eater)

Reptiles / Amphibians

- Pacific chorus frog
- Western pond turtle (Provolt only)
- Gopher snake
- Western fence lizard

These particular wildlife species were selected because they represent the majority of the species present, or the seed orchards have suitable habitat and are within their range (e.g., selection of black-capped chickadee as conifer seed-eater), and because they represent several types of coverage: a range of phylogenetic classes, body sizes, foraging habitat, and diets for which parameters are generally available. In addition, several special status terrestrial species were evaluated for potential risk:

- Bald eagles, a Federally listed threatened species, may hunt at Provolt Seed Orchard or occasionally pass through Sprague Seed Orchard.

- Vagrant northern spotted owls may also occasionally pass through or use Sprague or Provolt for roosting during dispersal.

- The common kingsnake is a state-listed species known to occur at Provolt.

- BLM sensitive species that could pass through Provolt or Sprague include the great gray owl and northern goshawk.

- The western pond turtle is a state-listed species that is found at both Provolt and Sprague.

For each species, characteristics were identified that were used in estimating doses of pesticides, other ingredients, and fertilizers. These characteristics include body weight, surface area, water intake, dietary intake, composition of diet, and home range / foraging area.

Risks were estimated for aquatic species for which ecotoxicity data are available: rainbow trout as a representative coldwater fish species, the water flea *Daphnia magna* as a representative aquatic invertebrate, and tadpoles of the Pacific chorus frog as a representative amphibian aquatic stage. In addition, five special status species known to be present in the watersheds were evaluated:

- Coho salmon is a Federally listed threatened and state-listed critical species.

- Steelhead and Pacific lamprey are state-listed vulnerable species.
- Chinook salmon and cutthroat trout are a state-listed critical species.

Stressor-response profiles were prepared for each pesticide, "other" ingredient, and fertilizer proposed for use at Provolt and Sprague. These profiles addressed ecotoxicity to both terrestrial and aquatic species, with the goal of identifying endpoints relevant to the types of exposure and methodology used in the assessment. The focus of this research was to identify LD_{50}s, LC_{50}s, and MATCs. The stressor-response profiles for all chemicals are presented in Section 8.3 of the risk assessment reports.

C.2.3 Risk Characterization

Risk characterization uses the results of the analysis phase to develop an estimate of the risks to ecological entities, describes the significance and likelihood of any predicted adverse effects, and identifies uncertainties, assumptions, and qualifiers in the risk assessment.

By comparing the exposure profile data (estimated dose or water concentration) to the stressor-response profile data (LD_{50}s, LC_{50}s, MATCs), an estimate of the possibility of adverse effects can be made. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs. The quotient is the ratio of the exposure level to the hazard level. For acute exposures, the levels of concern at which a quotient is concluded to reflect risk to non-target species are as follows:

- Terrestrial species (general): 0.5, where dose equals one-half the LD_{50}.
- Terrestrial species (special status): 0.1, where dose equals one-tenth the LD_{50}.
- Aquatic species (general): 0.5, where water concentration equals one-half the LC_{50}.
- Aquatic species (special status): 0.05, where water concentration equals one-twentieth the LC_{50}.

Due to the high level of concern for protecting threatened salmonids in the watershed, the predicted water concentrations are also compared to the MATC for a chemical, if available.

Quotients for each chemical and scenario are presented in tables in Section 9.0 of the risk assessment reports. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.7-2 of this EIS.

Risks to Terrestrial Wildlife

Risks to General Terrestrial Species

At Provolt, risks are predicted from chlorpyrifos for the black-capped chickadee in the typical and maximum scenarios. Risks are predicted from diazinon for the black-capped chickadee, western bluebird, and song sparrow in the maximum scenario. Dimethoate was estimated to present risks to the pocket gopher, black-capped chickadee, western bluebird, song sparrow, and Pacific chorus frog in the typical scenario, and to these same species plus the long-tailed vole, long-eared myotis, mallard duck, great blue heron, tree swallow, Canada goose, gopher snake, and western fence lizard in the maximum scenario.

At Sprague, risks are predicted from chlorpyrifos for the black-capped chickadee in the maximum scenario. Risks are predicted from diazinon for the black-capped

chickadee, western bluebird, and song sparrow in the maximum scenario. Dimethoate was estimated to present risks to the pocket gopher, black-capped chickadee, western bluebird, song sparrow, and Pacific chorus frog in the typical scenario, and to these same species plus the long-eared myotis, mallard duck, red-tailed hawk, tree swallow, Canada goose, gopher snake, and western fence lizard in the maximum scenario.

In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides and fertilizers proposed for use at the seed orchards under typical conditions of use, with the possible exception of impacts to bird, reptile, amphibian, and subterranean mammal species from applications of two of the insecticides (chlorpyrifos and dimethoate) at Provolt and one of the insecticides (dimethoate) at Sprague. Most of the estimated doses are extremely low, with risk quotients several orders of magnitude below the levels of concern. A margin for error is provided by the methodology applied, which uses reasonable assumptions that tend toward overstating potential exposures to wildlife, in the absence of site-specific data on potential exposure patterns. In addition, all of the chemicals have relatively short half-lives and are not expected to remain in the environment for significant periods of time.

Although some terrestrial insects onsite may be affected by the insecticide applications, and may constitute a portion of the dose to insectivorous species, populations of beneficial insects as a whole are not expected to suffer adverse impacts because the proposed seed orchard applications are localized. Although honeybees and other pollinators are generally susceptible to insecticides, the standard operating procedures at Provolt and Sprague include practices to mitigate potential exposures.

It appears that insecticide applications may have adverse impacts on local earthworm populations (see discussion in Section 9.2.1 of the risk assessment reports). However, any possible impacts are expected to be reversible, given that these chemicals are not persistent in the soil and that limited areas would be treated only on an as-needed basis in any growing season, allowing for re-population from adjacent untreated areas.

Risks to Special Status Terrestrial Species

At Provolt, risks are predicted from chlorpyrifos for the western pond turtle in the typical and maximum scenarios, and for the common kingsnake in the maximum scenario. Risks are predicted from diazinon for the western pond turtle and common kingsnake in the maximum scenario. Dimethoate was estimated to present risks to the western pond turtle and common kingsnake in the typical scenario, and to these same species plus the spotted owl and bald eagle in the maximum scenario.

At Sprague, chlorpyrifos and diazinon were predicted to pose risks to the western pond turtle in the maximum scenario. Dimethoate is associated with risk for the western pond turtle in the typical scenario, and risk to the western pond turtle, spotted owl, great gray owl, and northern goshawk in the maximum scenario. With the exception of risks to reptiles from dimethoate, typical conditions of application using the proposed pesticides and fertilizers are not expected to present risks to special status terrestrial species.

Risks to Terrestrial Plants

The proposed herbicides will be variously toxic to any plants with which they come into contact. Two special status plant species have been identified at Sprague. Herbicide-free buffer zones will be implemented for the protection of these species. Mechanical control of nearby weeds could be accomplished through mowing. Broadcast applications of herbicides are only proposed for intensively managed or disturbed areas such as along roads and fences, within orchard units, or around facilities, while spot applications will be used to control weed species in less disturbed areas. Only spot hand applications would be conducted within the riparian buffer areas. Insecticides, fungicides, and

fertilizers are only proposed for use in cultivated areas (seed orchard blocks), so no direct contact with plant species in other areas is expected.

Risks to Aquatic Species

Risks to General Aquatic Species

At Provolt, no risks were predicted for any aquatic invertebrates or tadpoles in the onsite irrigation ditches; nor for any coldwater fish species (represented by rainbow trout) in Williams Creek; nor for any coldwater fish, aquatic invertebrates, or tadpoles in the Applegate River from any pesticides or fertilizers proposed for use at Provolt.

At Sprague, no risks were predicted from any pesticides or fertilizers for any aquatic invertebrates or tadpoles in the onsite drainages; nor for any coldwater fish species (represented by rainbow trout) in Jump-off Joe Creek or its tributaries.

Risks to Special Status Aquatic Species

No risks to special status aquatic species in Williams Creek or the Applegate River were predicted from any pesticides or fertilizers proposed for use at Provolt. However, in the maximum scenario at Sprague, ammonia from runoff containing fertilizers was predicted to pose a risk to special status fish species south of the orchard in the main tributary to Jump-off Joe Creek. No risks were predicted from typical conditions of use at Sprague.

Risks from Accidents

Risks are predicted for all terrestrial species except the deer, coyote, raccoon, and dog in the accident scenario in which an animal ingests an acephate implant capsule.

At Provolt, aquatic invertebrates are at risk from a spill of chlorpyrifos concentrate at the mixing area, and special status aquatic species are at risk from a spill of esfenvalerate or permethrin concentrate. Spills of tank mix directly into streams were predicted to pose risks to coldwater fish (represented by rainbow trout) from chlorpyrifos; to aquatic invertebrates from chlorpyrifos, diazinon, esfenvalerate, and permethrin; and to special status species from chlorpyrifos, esfenvalerate, permethrin, chlorothalonil, and triclopyr.

At Sprague, special status species are at risk from a spill of esfenvalerate concentrate at the mixing area. Spills of tank mix directly into streams were predicted to pose risks to aquatic invertebrates and special status species from chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, and chlorothalonil.

Risks to Aquatic Plants

Aquatic plants may be present in streams and ponds that receive runoff from treated areas. A literature review was conducted to identify the levels at which any of the proposed chemicals may pose a hazard to aquatic plants. For many chemicals, tests in algae were the only available data, and are expected to provide a sensitive endpoint for hazards to aquatic plants. For each chemical, the estimated water concentrations were compared to the levels of concern. None of the predicted concentrations in onsite ditches, Williams Creek, or the Applegate River at Provolt; or onsite stream segments, Jump-off Joe Creek, or its tributaries at Sprague, exceed the effects criteria equivalent to 50% of the values reported in the literature reviewed. Therefore, no adverse effects to aquatic plants are expected under typical or maximum conditions of pesticide or fertilizer application at Provolt or Sprague.

Risk Management Approaches

If applications of these pesticides were prescribed, risks to wildlife species could be mitigated by measures such as decreasing the application rate, decreasing the area treated, decreasing the number of applications, and increasing the distance to surface water from treated areas. Field surveys could also be used to determine whether some special status species that were evaluated are actually present on the seed orchard lands or in downstream drainages.

Uncertainties

The risks summarized in this assessment are not probabilistic estimates of risk, but are conditional estimates. That is, these risks are likely only if all exposure scenario assumptions that were described are met. In addition, the methodology applied to estimating risks is not definitive, since uncertainty in the final risk estimates is introduced in almost every step of the assessment. Some of the primary areas of uncertainty are as follows:

- The information on each terrestrial species' range, diet, and other characteristics, compared to the characteristics it exhibits at the specific time of year when any particular application may be made.

- The LD_{50}s and LC_{50}s selected for use in the risk assessment, which are often drawn from data on species related to the species of interest, and not from tests on the species of interest itself.

- The necessity of using model-defined inputs and site-characterizing assumptions to depict the seed orchard and management activities for conducting the runoff, drift, and accidental spill modeling; as well as the accuracy of the models themselves, which provide an estimate of the impacts that could occur for purposes of prospective program evaluation, mitigation design, and alternative comparison, but are not able to be as accurate as data obtained from actual monitoring.

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Attachment
Proposed Application Methods

Pesticides may be applied using several methods. For some pesticides, different combinations of pesticide and application method are being proposed, to give the seed orchards flexibility in addressing the specific management needs that may occur, including:

- high-pressure hydraulic sprayer
- hydraulic sprayer with hand-held wand
- tractor-pulled spray rig with small boom
- backpack sprayer
- hand-held wick
- capsule implantation
- broadcast spreader

Only ground-based application methods are being proposed; aerial application is not part of this pest management program. Each method is described briefly in the following paragraphs.

High-Pressure Hydraulic Sprayer

High-pressure hydraulic sprayers consist of a powered pump and tank carried by truck or tractor, and hand-held nozzles for dispersing the solution upward into the tree. These sprayers could be used to treat individual mature trees with the insecticides chlorpyrifos, diazinon, esfenvalerate, horticultural oil, permethrin, or propargite; or with the fungicide chlorothalonil.

Hydraulic Sprayer with Hand-Held Wand

A spray tank is mounted on a truck, tractor, or all-terrain vehicle, and may be used to treat young trees; and to apply herbicides around trees in orchard units, along fencelines, and as a spot treatment in fallow fields, orchard units, and administrative areas. The sprayer may be operated by one worker, who drives and stops to spray; or by two workers, with one driving and the other spraying. This method may be used to apply the insecticides chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, or propargite; the fungicide chlorothalonil; or the herbicides dicamba, glyphosate, hexazinone, picloram, or triclopyr.

Tractor-Pulled Spray Rig with Boom

This method may be used to apply herbicides for control of weeds in orchard units, in roadways, or in fallow areas. Equipment consists of a hydraulic spray tank pulled by a tractor or heavy-duty pickup truck, with a spray boom attached to the tank to release the herbicide. At Provolt and Sprague, this method may be used to apply the herbicides dicamba or glyphosate.

Backpack Sprayer

A backpack sprayer consists of a plastic tank that is strapped to the applicator's back. A hand-operated hydraulic pump forces the liquid from the tank through a nozzle in a hand-held wand. At Provolt and Sprague, a backpack sprayer could be used to apply the insecticides dimethoate, esfenvalerate, permethrin, or propargite; or the herbicides dicamba, glyphosate, hexazinone, picloram, or triclopyr for treatment of unwanted vegetation in orchard units and along fencelines.

Hand-Held Wick

A hand-held wick consists of a stick containing diluted herbicide in contact with an absorbent material (a rope or wiper pad), which is then wiped directly on the foliage of target vegetation. This method may be used to apply dicamba or glyphosate for spot treatment of weeds.

Capsule Implantation

The insecticide acephate may be implanted into individual trees for long-term control of insect pests in the form of a capsule. One small hole is drilled into a tree for every 4 inches of its circumference, and a capsule is inserted.

Broadcast Spreader

Fertilizers may be distributed over the ground using a spreader pulled by a truck, or mounted on a tractor or all-terrain vehicle.

Appendix D: Risk Analysis of Sublethal Effects for Special Status Aquatic Species

D.1 Methodology

In the non-target species risk assessments (summarized in Appendix C), it was postulated that species of fish may be exposed to pesticides or fertilizers through contaminated surface runoff or from drift during application. For each chemical, acute lethality data were evaluated for a representative species, the rainbow trout. Based on this information, mortality risks were also evaluated for five special status species known to be present in the Williams Creek watershed and Applegate River sub-basin in which Provolt is located, and in the Jump-off Joe Creek watershed where Sprague is located: coho and chinook salmon, cutthroat and steelhead trout, and the Pacific lamprey.

In the quantitative aquatic species risk assessment, if data were available for sublethal or long-term toxic effects, a maximum acceptable toxicant concentration (MATC) was determined. The MATC is the geometric mean of a no-observable-effect concentration (NOEC) and a lowest-observed-effect concentration (LOEC). This further analysis of risks to special status aquatic species expands upon the MATC approach by estimating risks that are relevant to the biological requirements of the animal: in this case, survival, rearing and migration, and reproductive endpoints.

The *assessment endpoints* used to characterize potential sublethal effects reflect measures of the animal's health that can be functionally related to survival, migratory, or reproductive success (Washington State Pesticide/ESA Task Force 2001). The attributes of the assessment endpoints are termed *assessment measures*, which are defined by a *quantifiable measure* (EPA 1998a). For example, reduced swimming speed (quantifiable measure) can increase susceptibility to predation (assessment measure) which can ultimately threaten survival (assessment endpoint). Since $1/20^{th}$ of the acute lethality (LC_{50}) value has been presumed to be protective of sublethal effects in threatened and endangered fish species (EPA 1986, EPA 1999a), it has been included here as a "sublethal survival" endpoint.

Since relatively few scientific studies have examined sublethal effects of pesticides on fish physiology or behavior, the selection of assessment endpoints is limited by available scientific and commercial literature. In the absence of data specific to the identified species of concern, data from biologically and genetically similar surrogate species are used. Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity (within an order of magnitude) to other species tested under the same conditions. Dwyer et al. (1995) and Beyers et al. (1994) have shown that some species of threatened and endangered fish are similarly sensitive to some classes of pesticides and other chemicals as their non-endangered counterparts. Very few studies have investigated the effects of pesticides specific to the lamprey, so comparative toxicity with fish species from available literature is made cautiously. In some cases, in the absence of pesticide-specific data for a fish species, data for pesticides that are chemically similar and share a common mechanism of toxicity were substituted.

For the purpose of broadening and strengthening the best available science for this evaluation, the proposed-use chemicals are analyzed by chemical groups. The insecticides and acaricides are divided by chemical classes (biologicals, organophosphates, organosulfites, and pyrethroids), reflecting the common mechanism of action for each class. The herbicides are evaluated as a group, based on the most sensitive toxicity findings. The one fungicide proposed for use in the Medford seed orchards is evaluated individually. Pesticides that do not fit in specific categories

are grouped as "other pesticides". The other pesticides, "other" (formerly "inert") ingredients, and fertilizers are evaluated within their respective groups. In each case, the lowest toxicity result (indicating greatest toxicity) was used in the analysis of risks, so that this categorization approach would not sacrifice a protective analysis.

D.2 Literature Review of Toxicity Data

D.2.1 Insecticides and Acaricides

Biological

This group includes the insecticide *Bacillus thuringiensis* (*B.t.*).

The mode of action for *B.t.* is a disruption of the digestive tract. After an insect ingests a crystal of *B.t.*, the biopesticide dissolves in the alkaline gut. The toxin that is released binds to the lining of the midgut membrane, creating pores and upsetting ion balance. A similar mechanism of toxicity is assumed for fish.

Table D-1 lists relevant assessment endpoints and effect concentrations of *B.t.* to fish species as identified from the literature.

B.t. is practically nontoxic to aquatic vertebrate species, and only one identified study has investigated sublethal effects relevant to the assessment endpoints and measures for the essential biological requirements of special status fish species. Field observations of populations of brook trout, common white suckers, and smallmouth bass found no adverse effects to populations one month after an aerial application of the *B.t.* HD-1 formulation (Abbott Laboratories 1982).

Table D-1. Effects of *Bacillus thuringiensis* on Fish Species

Assessment Endpoints	Assessment Measures	Species	Formulation	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	HD-1	> 112	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	bluegill	HD-1	> 200	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	European eel	HD-1	200 - 400 times field rates	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	trout	israelensis	75 - 100	Merritt 1999
Migration					
NA[c]					
Reproduction					
Success	population (number)	brook trout	HD-1	typical aerial application	Abbott Laboratories 1982

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = Not available.

B.t. israelensis was tested for possible impacts on non-target invertebrates. Its use over a three-year period did not disturb the prey base of fish. No negative impacts were observed on invertebrate predators (Plecoptera, Odonata, Megaloptera, Trichoptera, Diptera) or grazers (Trichoptera, Ephemeroptera). Predators often consumed more *B.t.*-contaminated (dead) black fly larvae than live larvae with no adverse effects. Detritivores (mainly mayflies) consumed large amounts of *B.t.*-contaminated black fly larvae, resulting in increased body mass and shorter developmental times. Some Diptera species were sensitive to high doses of *B.t.* israelensis (>100 times the normal field dose) (Merritt 1999).

B.t. is moderately persistent in soils, with a half-life of about 4 months (Extoxnet 1996). In soils with a pH below 5.1, *B.t.* is rapidly inactivated. It does not tend to move, or leach, with groundwater. After 48 hrs, *B.t.* begins to inactivate in water, gradually settling out or adhering to suspended organic matter.

Organophosphates

This group includes the insecticides acephate, chlorpyrifos, diazinon, and dimethoate.

Organophosphate insecticides are highly toxic to fish. The primary mechanism of this toxicity is generally well understood, with inhibition of acetylcholinesterase (AChE) being the critical target. The function of AChE is to hydrolyze the neurotransmitter acetylcholine at synaptic junctions, terminating nervous stimulation. Inhibition of AChE is followed by an accumulation of acetylcholine, resulting in a continuous stimulation at cholinergic and muscarinic receptors. Relationships between AChE inhibition and biological function for fish have been investigated and include alterations in growth, reproduction, maturation, swimming, hyperactivity, and feeding. Organophosphate insecticides can target AChE located in the central and peripheral nervous system, and in the neuro-muscular junctions. Inhibition of AChE at these regions can affect behavioral processes, sensory systems, and swimming ability in fish.

Table D-2 lists relevant assessment endpoints and effect concentrations of acephate, chlorpyrifos, diazinon and dimethoate and other relevant organophosphates to salmonid species and the European eel.

Scholz et al. (2000) exposed juvenile chinook salmon to concentrations of diazinon ranging from 0.0001 to 0.010 mg/L for two hours and then allowed them to recover for one hour. After exposures, anti-predator behaviors were observed when skin extracts from juvenile salmon were added to the trial tanks. At concentrations of 0.001 and 0.010 mg/L, the fish failed to respond to the olfactory cue. Rainbow trout showed altered swimming patterns when exposed to diazinon for 24 to 96 hours, at concentrations ranging from 0.25 to 1.0 mg/L (Brewer et al. 2001).

The European eel, when exposed to diazinon or chlorpyrifos, exhibited signs of restlessness, erratic swimming, convulsions and difficulty in respiration at acutely toxic concentrations of 0.16 and 1.29 mg/L, respectively, after 24 hours (Ferrando et al. 1991). When rainbow trout were exposed to 0.01 mg/L methyl parathion for 96 hours, swimming activity decreased and the fish were more vulnerable to predation by bass. Of control fish, 84% survived predation, as opposed to 57% of the exposed fish (Little et al. 1990).

Table D-2. Effects of Organophosphates on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout cutthroat trout brook trout	acephate	44.8 > 20.0 > 20.0	EPA 1984
mortality	1/20 LC_{50}[b]	rainbow trout cutthroat trout lake trout	chlorpyrifos	0.006 0.003 0.020	EPA 2000a
mortality	1/20 LC_{50}[b]	rainbow trout cutthroat trout lake trout	diazinon	0.018 0.34 0.12	Johnson and Finley 1980
mortality	1/20 LC_{50}[b]	brook trout	diazinon	0.15	Allison and Hermanutz 1977
mortality	1/20 LC_{50}[b]	European eel	diazinon	0.008	Sancho et al. 1992
mortality	1/20 LC_{50}[b]	European eel	chlorpyrifos	0.065	Ferrando et al. 1991
mortality	1/20 LC_{50}[b]	rainbow trout	dimethoate	1.24	EPA 1999b
predation	olfactory anti-predatory response (food strikes, activity)	chinook salmon	diazinon	0.001	Scholz et al. 2000
predation	swimming (distance, speed, turning rate, tortuosity of path)	rainbow trout	diazinon	0.250	Brewer et al. 2001
predation	survival (predation by Large mouth bass)	rainbow trout	methyl parathion[c]	0.01	Little et al. 1990
predation	swimming (erratic pattern)	European eel	diazinon	0.16	Ferrando et al. 1991
predation	swimming (erratic pattern)	European eel	chlorpyrifos	1.29	Ferrando et al. 1991
growth	foraging (prey ingestion)	Atlantic salmon	fenitrothion[c]	0.006	Morgan and Kiceniuk 1991
Migration					
upstream return	homing (number returning to hatchery)	chinook salmon	diazinon	0.010	Scholz et al. 2000
rearing	Territory defense (location)	Atlantic salmon	fenitrothion[c]	0.1	Symons 1973
rearing	territory defense (agonistic behaviors)	coho salmon	fenitrothion[c]	0.1	Bull and McInerney 1974
Reproduction					
mating	detection of mate (electrophysiology)	Atlantic salmon	diazinon	0.001	Moore and Waring 1996
physiology	biological stimulation (hormone production, expressible milt)	Atlantic salmon	diazinon	0.0003	Moore and Waring 1996

[a] Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] Not proposed for use in seed orchard by BLM; data used for assessment purposes only.

Foraging behaviors were tested in Atlantic salmon exposed to fenitrothion for two 24-hour periods separated by seven days. At concentrations of 0.006 and 0.21 mg/L, the reaction distance of the salmon to respond to prey decreased significantly (Morgan and Kiceniuk 1991).

Exposure of juvenile Atlantic salmon to 0.1 mg/L fenitrothion for 15 to 16 hours caused a 20% decrease in the number of fish that were able to maintain and hold territories six days following treatments (Symons 1973). The territories were not reclaimed for approximately two to three weeks. Some severely affected fish swam stiffly and ceased feeding, but recovery to these effects was evident within 48 hours after returning to clean water. Coho salmon showed very similar behavioral changes over the same concentration range (Bull and McInerney 1974). When adult chinook salmon were treated with 0.010 mg/L diazinon and re-released downstream of their native hatchery, the number of returns was significantly lower than unexposed control fish.

Following a direct perfusion-exposure of diazinon directly over the olfactory epithelium, adult male Atlantic salmon showed inhibited olfactory stimulation in response to a female reproductive pheromone (Moore and Waring 1996). Concentrations of diazinon affecting olfactory sensitivity ranged from 0.001 to 0.02 mg/L. The same study found that diazinon exposures of 0.0003 to 0.045 mg/L reduced the production of reproductive hormones and viable sperm in the males when presented with the female priming pheromone.

Environmental factors may also influence organophosphate toxicity to aquatic species, altering effect estimates to the fish (Table D-3). A number of studies tested environmental effects on the toxicity of chlorpyrifos and azinphos-methyl to salmonids. Parameters included temperature, pH, water hardness, fish size, and static versus flow-through exposures. In general, acute toxicity of chlorpyrifos and azinphos-methyl were found to increase with temperature, pH, and body size of the fish. Increasing hardness tended to reduce the toxicity of chlorpyrifos, and static exposure tests produced lower lethality values than those from flow-through tests.

Table D-3. Environmental Factors Influencing Organophosphate Toxicity to Fish

Environmental Factor	Assessment Measures	Species	Chemical	Reference
temperature	24-hr LC_{50} (2, 7, 13°C)	rainbow trout	chlorpyrifos	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13°C)	rainbow trout	chlorpyrifos	Macek et al. 1969
temperature	24-hr LC_{50} (2, 7, 13°C)	rainbow trout	azinphos-methyl[a]	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13°C)	rainbow trout	azinphos-methyl[a]	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13, 18°C)	rainbow trout	chlorpyrifos	EPA 2000a
pH	96-hr LC_{50} (7.5, 9.0)	cutthroat trout	chlorpyrifos	EPA 2000a
hardness	96-hr LC_{50} (44, 162 mg/L $CaCO_3$)	lake trout	chlorpyrifos	EPA 2000a
exposure system	96-hr LC_{50} (static, flow through)	lake trout	chlorpyrifos	EPA 2000a
body weight	96-hr LC_{50} (0.3 2.9 g)	lake trout	chlorpyrifos	EPA 2000a

[a]Not proposed for seed orchard use by BLM; data used for assessment purposes only.

Organosulfites

This group includes the acaricide propargite.

EPA lists propargite as a probable human carcinogen, meaning there is a possibility of causing cancer in animals as well. Propargite is highly toxic to fish.

Table D-4 lists relevant assessment endpoints and effect concentrations of propargite to fish species as identified from the literature.

A chronic test in fathead minnows showed that propargite affected growth and survival at a concentration of 0.028 mg/L; the NOEC was 0.016 mg/L (EPA 2000b). Acute mortality data for the catfish are used in the risk evaluation for the survival endpoint, since this was the most sensitive endpoint identified.

For reproductive parameters, a chronic test in fathead minnows showed that propargite affected growth, survival, and day to hatch at a concentration of 0.028 mg/L; the NOEC was 0.016 mg/L (EPA 2000b).

No data are currently available for migratory effects endpoints or environmental influences on toxicity.

Pyrethroids

The pyrethroid insecticide group includes esfenvalerate and permethrin.

Pyrethroids are highly toxic to fish, generally with acute LC_{50} values for salmonids near or below 0.001 mg/L. The mode of action for pyrethroids is the blocking of neural voltage-activated sodium/calcium channels, producing common symptoms of toxicity for the various synthetic compounds. The sensitivity of fish to pyrethroids, compared to other vertebrates, has been explained, in part, by the fishes' inability to metabolize and excrete the toxins (Haya 1989). A comparative study between steelhead trout and coho

Table D-4. Effects of Organosulfites on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	propargite	0.024	EPA 2000b
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	bluegill	propargite	0.034	Uniroyal 1998
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	minnow	propargite	0.012	Uniroyal 1998
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	catfish	propargite	0. 008	Uniroyal 1998
growth	size (length, weight)	fathead minnow	propargite	0.028	EPA 2000b
Migration					
NA[c]					
Reproduction					
success	day to hatch (mean number)	fathead minnow	propargite	0.028	EPA 2000b

[a] Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = Not available.

salmon showed that both species were similarly sensitive across the five pyrethroids tested (Mauck and Olson 1976). Thus, incorporating data from pyrethroids of similar toxicity across similar fish species should provide adequate estimates where salmonid data gaps are present.

Table D-5 lists relevant assessment endpoints and effect concentrations of esfenvalerate, permethrin, and other pyrethroids to fish species as identified from the literature. Note that the active isomer of fenvalerate is esfenvalerate.

Table D-5. Effects of Pyrethroids on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	esfenvalerate	0.001	Du Pont 1999
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	steelhead trout	fenvalerate	0.00035	Curtis et al. 1985
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	permethrin	0.0043	Mayer and Ellersieck 1986
growth	feeding (mortality from stress)	Atlantic salmon	fenvalerate	0.008	Haya 1989
growth	size (length, weight)	sheepshead minnow	fenvalerate	0.002	Hansen et al. 1983
predation	swimming (tremors)	bluegill	esfenvalerate	0.000025	Little et al. 1993
predation	swimming (critical speed)	rainbow trout	permethrin	0.00075	Kumaraguru et al. 1982
predation	avoidance behavior (startle response)	Japanese medaka	permethrin	0.009	Rice et al. 1997
predation	behavior (equilibrium, coughing)	rainbow trout	permethrin	0.0013	Holcombe et al. 1982
Migration					
behavior	schooling (location, grouping pattern)	fathead minnow	permethrin	0.007	Holcombe et al. 1982
rearing	territory defense (aggression)	bluegill	esfenvalerate	0.0001	Little et al. 1993
Reproduction					
mating	detection of mate (electrophysiology)	Atlantic salmon	cypermethrin[c]	0.00001	Moore and Waring 2001
physiology	biological stimulation (hormone production, expressible milt)	Atlantic salmon	cypermethrin[c]	0.000004	Moore and Waring 2001
success	recruits (number per female)	bluegill	esfenvalerate	0.00067	Fairchild et al. 1992
success	egg hatch (number) larvae survive (number) larvae abnormality (deformities)	Australian crimson-spotted rainbowfish	esfenvalerate	0.001 0.032 0.032	Barry et al. 1995

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] Not proposed for seed orchard use by BLM; data used for assessment purposes only.

Pyrethroids have been documented to affect behavior and physiology in fish important for survival. Sublethal effects observed in fish include alterations in growth, metabolic processes, swimming, a reduced startle response, loss of equilibrium, body tremors, and depressed olfactory sensitivity.

Juvenile Atlantic salmon exposed to 0.008 mg/L fenvalerate were unable to survive the stress of hunger over a 70-hour period, with mortality resulting in over half of the test animals (Haya 1989). Growth was reduced in sheepshead minnow fry exposed to fenvalerate concentrations $\geq$ 0.002 mg/L over a period of 28 days (Hansen et al. 1983).

Primary toxicity involves disruption to the neuromuscular system, affecting swimming and other coordinated muscular movement. Gross body tremors of juvenile bluegill continually or pulse-exposed to esfenvalerate were sensitive indicators of toxicity at concentrations as low as 0.000025 mg/L (Little et al. 1993). Rainbow trout exposed to 0.00075 mg/L permethrin showed a substantial decrease in swimming performance that was related to exposure duration, from one to 43 days (Kumaraguru and Beamish 1986). This effect was attributed to an increased metabolic rate and a higher demand in oxygen consumption. After a 24-hour exposure to >0.009 mg/L permethrin, Japanese medaka were hypoactive and underreactive to startle stimuli (Rice et al. 1997). Rainbow trout exposed for 48 hours to permethrin at 0.0013 mg/L caused rapid gill movements and a pattern of swimming at the water surface (Holcombe et al. 1982).

Juvenile selection of rearing habitat, smolt outward migration, and adult homing are behaviors related to successful migration. Aggression of bluegill, a response of the fish to defend rearing territory, was significantly lower among fish exposed to pulsed 11-hour concentrations of 0.0001 mg/L esfenvalerate (Little et al. 1993). Schooling behavior of fathead minnows was affected at 0.0072 mg/L permethrin (Holcombe et al. 1982).

Following a five-day exposure to 0.00001 mg/L cypermethrin (nominal concentration), male Atlantic salmon showed inhibited olfactory stimulation to a female reproductive pheromone (Moore and Waring 2001). The same study found that exposures < 0.000004 mg/L reduced biochemical responses to the pheromone and caused a reduction of viable sperm produced.

Barry et al. (1995) studied the effects of esfenvalerate exposure to the Australian crimson-spotted rainbowfish over a period of six days. At 0.001 mg/L, there was a significant decrease in the number of larvae hatching per spawning day. Hatchability of eggs was affected and there was an increase in abnormalities in larvae at a concentration of 0.032 mg/L. In an aquatic mesocosm study of esfenvalerate on bluegill, reproductive success, as defined by the number of offspring per female, was decreased at a concentration of 0.00067 mg/L (Fairchild et al. 1992).

Environmental factors may also influence pyrethroid toxicity to aquatic species, altering effect estimates to fish (Table D-6). Pyrethroid insecticides readily bind to organic matter in the soil, have little mobility, and are practically insoluble in water. When caged rainbow trout were exposed to cypermethrin in a pond containing 14 to 22 mg/L suspended solids, the amount of pesticide necessary to result in mortality increased by nearly five times (from 0.001 to 0.005 mg/L) (Shires 1983). Rainbow trout became more sensitive to permethrin with increasing water temperature (Kumaraguru and Beamish 1986). The 96-hour LC_{50} values decreased by nearly an order of magnitude (0.0064 to 0.00069 mg/L) between 10 and 20 °C, respectively. Toxicity of four pyrethroids to coho salmon and steelhead trout was not influenced by pH in the range of 6.5 to 9.5, or by water hardness ranging from 10 to 300 mg/L $CaCO_3$ (Mauck and Olson 1976).

Table D-6. Environmental Factors Influencing Pyrethroid Toxicity to Fish

Environmental Factor	Assessment Measures	Species	Chemical	Reference
turbidity	96-hr LC_{50} (suspended solids)	rainbow trout	cypermethrin[b]	Shires 1983
temperature	96-hr LC_{50} (5 - 25°C)	rainbow trout	permethrin	Kumaraguru et al. 1982
hardness[a] pH	96-hr LC_{50} (10 - 300) 96-hr LC_{50} (6.5 - 9.5)	coho salmon steelhead trout	dimethrin[b] d-trans allethrin[b] RU-11679[b] s-bioallethrin[b]	Mauck and Olson 1976

[a] As mg/L CaCO3.
[b] Not proposed for seed orchard use by BLM; data used for assessment purposes only.

D.2.2 Herbicides

The herbicides evaluated are dicamba, glyphosate, hexazinone, picloram, and triclopyr.

Classification of herbicides by chemical structure for evaluating toxic effects in fish is not practical because the mechanism by which herbicides elicit toxicity in animals is non-specific, with a broad overlapping of biological effects. Another method is to classify herbicides by their acute toxicity to fish as presented below. One proposed-use herbicides is classified as very highly or highly toxic to fish. Two herbicides are considered moderately or slightly toxic to fish. Two herbicides are considered practically non-toxic to fish.

- Very highly (<0.1 mg/L) and highly toxic (0.1 to 1.0 mg/L) to fish: triclopyr butoxyethyl ester.
- Moderately (1.0 to 10 mg/L) and slightly toxic (10 to 100 mg/L) to fish: picloram and dicamba.
- Practically non-toxic (>100 mg/L) to fish: glyphosate, hexazinone.

Herbicides do not typically elicit a specific mechanism of toxicity to fish. Toxicity is often associated with skin and eye irritations, nausea, hemorrhages, and kidney and liver inflammation in mammals which can eventually lead to mortality. The gill, liver, and kidneys are often the target organs for herbicides in fish.

Table D-7 lists relevant assessment endpoints and effect concentrations of dicamba, glyphosate, hexazinone, picloram, and triclopyr to fish species as identified from the literature.

Based on available information, chronic picloram toxicity to fish is not cumulative in terms of lethality (Woodward 1976). However, long-term exposures have been shown to affect fish development and growth. It was observed that the NOEC of technical grade picloram for lake trout was apparently <0.035 mg/L, as this level of herbicide reduced fry survival and growth. Most abnormalities occurred during yolk absorption, which took four to five days longer in picloram-treated fish. Morgan and Kiceniuk (1992) observed no effects of glyphosate exposure on growth and weight, or foraging activities at concentrations up to 0.1 mg/L for 12 hours. In an early lifestage test for hexazinone using the fathead minnow, a NOEC of 17 mg/L was determined, with fish length affected at the LOEC of 35.5 mg/L (EPA 1994).

Table D-7. Effects of Herbicides on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	dicamba	1.8	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	dicamba	10	Caux et al. 1993
mortality	1/20 LC_{50}[b]	coho salmon	dicamba	5.5 (6-day)	Caux et al. 1993
mortality	1/20 LC_{50}[b]	cutthroat trout	dicamba/ picloram mixture	10	Woodward 1982
mortality	1/20 LC_{50}[b]	rainbow trout	glyphosate	1.6	EPA 1993a
mortality	1/20 LC_{50}[b]	chinook salmon	glyphosate	1.9	Mitchell et al. 1987
mortality	1/20 LC_{50}[b]	coho salmon	glyphosate	2.2	Mitchell et al. 1987
mortality	1/20 LC_{50}[b]	sockeye salmon	glyphosate	5.3	Servizi et al. 1987
mortality	1/20 LC_{50}[b]	rainbow trout	hexazinone	16	Wan et al. 1988
mortality	1/20 LC_{50}[b]	coho salmon	hexazinone	14.5	Wan et al. 1988
mortality	1/20 LC_{50}[b]	chum salmon	hexazinone	16.1	Wan et al. 1988
mortality	1/20 LC_{50}[b]	chinook salmon	hexazinone	19.7	Wan et al. 1988
mortality	1/20 LC_{50}[b]	pink salmon	hexazinone	15.5	Wan et al. 1988
mortality	1/20 LC_{50}[b]	sockeye salmon	hexazinone	18.2	Wan et al. 1988
mortality	1/20 LC_{50}[b]	rainbow trout	picloram	0.16	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	picloram	0.17	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	lake trout	picloram	0.09	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	picloram/ dicamba mixture	0.8	Woodward 1982
mortality	1/20 LC_{50}[b]	rainbow trout	triclopyr (triethylamine salt)	47.4	EPA 1998b
mortality	1/20 LC_{50}[b]	rainbow trout	triclopyr (BEE)[c]	0.033	EPA 1998b
mortality	1/20 LC_{50}[b]	chinook salmon	triclopyr (BEE)[c]	0.088	Kreutzweiser et al. 1994
mortality	1/20 LC_{50}[b]	coho salmon	triclopyr (BEE)[c]	0.052	Mayes et al. 1986

Table D-7. Effects of Herbicides on Fish Species (continued)

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
growth	size (length, weight)	cutthroat trout	picloram	0.61	Woodward 1979
growth	size (length, weight)	lake trout	picloram	0.035	Woodward 1976
growth	size (length, weight)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
growth	foraging (rearing distance, attacks, captures, ingestion)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
growth	size (length)	fathead minnow	hexazinone	35.5	EPA 1994
fitness	hypersensitivity to stimuli	coho salmon	triclopyr (BEE)[c]	0.10	Johansen and Geen 1990
fitness	lethargic (spontaneous activity)	coho salmon	triclopyr (BEE)[c]	0.32	Johansen and Geen 1990
Migration					
rearing	territory defense (agonistic behaviors)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
adaptation	osmoregulation (gill lesions)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
adaptation	sea water challenge (mortality)	coho salmon	dicamba	0.25	Lorz et al. 1979
adaptation	sea water challenge (mortality)	coho salmon	picloram	0.25	Lorz et al. 1979
adaptation	sea water challenge (mortality)	coho salmon	glyphosate	2.8 (NOEC)	Mitchell et al. 1987
Reproduction					
success	fecundity (egg number) gonadosomatic index (gonad/body)	rainbow trout	glyphosate	2.0 (NOEC)	Folmar et al. 1979
success	larval survival (number)	rainbow trout	picloram	2.0	Mayes et al. 1987

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] BEE - butoxyethyl ester

The toxicity of triclopyr (butoxyethyl ester) at a concentration lower than 0.56 mg/L reduced spontaneous swimming activity in coho salmon after 96-hour exposures (Johansen and Geen 1990). At concentrations lower than 0.10 mg/L, fish were very sensitive to stimuli. At slightly higher concentrations, they were initially sensitive prior to reaching a pronounced state of lethargy. It was suggested that the formulation affected the nervous system of the fish.

There was no effect of dicamba on gill ATPase activity of coho salmon exposed up to 100 mg/L for 144 hours (Lorz et al. 1979). (ATPase is an enzyme that is needed for energy-requiring cellular activities to take place.) Histological examination of gill, liver, and kidney tissue indicated no apparent effects. When challenged with seawater, fish previously exposed to the lowest level of 0.25 mg/L showed a 32% mortality during the 11 days of the test. When coho salmon were treated with picloram at 0.25 mg/L for 144 hours, 25% mortality occurred. Inexplicably, no deaths occurred at the higher exposure concentrations for both herbicides. There was no apparent effect of picloram on the ATPase activity of the gills. Histological examination of fish exposed to 5.0 mg/L revealed abnormal liver and gill tissues. Mitchell et al. (1987) exposed coho salmon to glyphosate for 10 days at concentrations up to 2.8 mg/L, with no effect on successful seawater adaptation.

Rainbow trout exposed for two months to glyphosate had no significant increase in gill lesions, and fish did not show any change in agonistic activity that would be important for territorial defense (Morgan and Kiceniuk 1992).

Rainbow trout exposed up to 2.0 mg/L glyphosate for 12 hr showed no effect on fecundity (eggs per female) and gonadosomatic index (gonad weight/total body weight) (Folmar et al. 1979). Tests with the early lifestages of rainbow trout showed that picloram concentrations of 2 mg/L reduced survival of the larvae (Mayes et al. 1987).

Environmental factors may influence herbicide toxicity to aquatic species, altering the effect estimates to fish (Table D-8). Glyphosate toxicity to rainbow trout increased with higher test temperatures (Folmar et al. 1979). Toxicity increased from pH 6.5 to 7.5, but did not change up to pH 9.5. Increasing temperature and pH with exposures to picloram resulted in greater toxicities to cutthroat trout and lake trout (Woodward 1976). The specific content of $CaCO_3$ in the tested "soft", "hard", and "very hard" waters was not

Table D-8. Environmental Factors Influencing Herbicide Toxicity to Fish

Environmental Factor	Assessment Measure	Species	Chemical	Reference
temperature	96-hr LC_{50} (7 - 17°C)	rainbow trout	glyphosate	Folmar et al. 1979
temperature	96-hr LC_{50} (5 - 15°C)	cutthroat trout	picloram	Woodward 1976
temperature	96-hr LC_{50} (5 - 15°C)	lake trout	picloram	Woodward 1976
pH	96-hr LC_{50} (6.5 - 9.5)	rainbow trout	glyphosate	Folmar et al. 1979
pH	96-hr LC_{50} (6.5 - 8.5)	cutthroat trout	picloram	Woodward 1976
pH	96-hr LC_{50} (6.5 - 8.5)	lake trout	picloram	Woodward 1976
hardness [a]	96-hr LC_{50} ("soft", "hard", very hard")	cutthroat trout	picloram	Woodward 1976
hardness [a]	96-hr LC_{50} ("soft", "hard", very hard")	lake trout	picloram	Woodward 1976
lifestage	96-hr LC_{50} (eyed eggs, sac fry, swim up fry, fingerling 1.0g, fingerling 2.0g)	rainbow trout	glyphosate	Folmar et al. 1979

[a] Content of CaCO3 not specified.

specified, but were reported not to alter toxicity. Eyed eggs were the least sensitive lifestage, with toxicity increasing markedly as the fish entered the sac fry and early swim-up stages.

D.2.3 Fungicides and Fumigants

The fungicide proposed for use is chlorothalonil.

Classification of fungicides by chemical structure for evaluating toxic effects in fish is not practical because the mechanism by which they elicit toxicity in animals is non-specific, with a broad overlapping of biological effects. Unlike the herbicides, fungicides can be highly toxic to animals, because the target microorganisms have common cellular systems. However, the same classification method was used to categorize the fungicide chlorothalonil, based on its acute toxicity to fish. Chlorothalonil falls into the category of "very highly (<0.1 mg/L) to highly toxic (0.1 to 1.0 mg/L) to fish".

This fungicide produces positive results in the usual microbial mutagenicity test systems (Ecobichon 1996). The microorganisms (salmonella, coliforms, yeasts, and fungi) used in these test systems are similar to those cell systems that fungicides were designed to target. It is possible that this fungicide is mutagenic to higher animals as well.

Table D-9 lists relevant assessment endpoints and effect concentrations of chlorothalonil to fish species as identified from the literature.

Caux et al. (1996) reported a chronic 21-day LOEC for chlorothalonil of 0.0049 mg/L for rainbow trout with mortality as the endpoint.

A full life-cycle aquatic toxicity test with chlorothalonil resulted in a NOEC of 0.003 mg/L in fathead minnows, with hatching success and survivability affected at the LOEC of 0.0065 mg/L (EPA 1999a).

No data are currently available relevant to migratory effects or environmental influences on toxicity.

Table D-9. Effects of Fungicide on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	chlorothalonil	0.0085	EPA 1999a
survival	21-day mortality (1/20 LC_{50})	rainbow trout	chlorothalonil	0.0049	Caux et al. 1996
Migration					
NA[c]					
Reproduction					
success	hatching (number, survivability)	fathead minnow	chlorothalonil	0.0065	EPA 1999a

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = No data available.

D.2.4 Other Pesticides

The pesticide horticultural oil does not fit within the previously assessed categories.

No mortality or indications of toxicity were observed in 96-hour studies in which rainbow trout, bluegill sunfish, and juvenile rainbow trout were exposed to horticultural oil at a concentration of 100 mg/L (Valent USA 1983, Wildlife International 1991). Although no LC_{50} values were determined, the value of 100 mg/L was used as the toxicity data point for fish species in the risk assessment, due to the lack of additional exposure-response information.

No data are currently available on migratory or reproductive endpoints or environmental influences on toxicity.

D.2.5 "Other" Ingredients

In addition to active ingredients, pesticide products contain a certain percentage of "other" ingredients (previously termed "inert" ingredients), which enhance the action of the active ingredient. Other ingredients can include surfactants, carriers, or preservatives. Some of the formulations proposed for use contain one or more of the following other ingredients: cyclohexanone, ethylbenzene, light aromatic solvent naphtha, and xylene.

Cyclohexanone, ethylbenzene, naphthalene (as an example of a light aromatic solvent naphtha), and xylene are hydrocarbons with solvent properties, having broad toxicological effects in fish. However, the primary target for acute exposure appears to be the gills.

Xylene occurs in three isomers which vary in the site of attachment on the benzene ring of the two methyl groups. Technical xylene typically contains mixed proportions of *o*-, *m*-, and *p*- isomers, with varying toxicity to fish. For the purposes of this assessment, all xylene isomers will be regarded as xylene.

Table D-10 lists relevant assessment endpoints and effect concentrations of cyclohexanone, ethylbenzene, light aromatic solvent naphtha, and xylene to fish species as identified from the literature.

Morrow et al. (1975) found that 100 mg/L xylene killed 100% of young coho salmon, and that 1 to 10 mg/L caused no significant mortality. Toxic symptoms before death included rapid, violent and erratic swimming, "coughing", and loss of equilibrium. Rainbow trout exposed to 3.2 and 6.2 mg/L xylene for 2 hours showed symptoms similar to anesthesia (Walsh et al. 1977).

Rainbow trout significantly avoided xylene at a nominal concentration of 0.1 mg/L during a one-hour test (Folmar 1976). Fish exposed to 0.001 mg/L did not show significant avoidance and those exposed to 0.01 mg/L were significantly attracted to the xylene. Maynard and Weber (1981) found that juvenile coho salmon avoided *o*-xylene at concentrations greater than 0.2 mg/L.

Kjorsvic et al. (1982) exposed cod eggs to xylene isomers in covered glass dished and monitored the effects both during fertilization and during early cleavage of fertilized eggs. Both *m*-xylene and *p*-xylene induced significant decreases in the fertilization rate at concentrations above 10 mg/L. Effects on the early cleavage pattern were significant for xylene concentrations between 2 and 7 mg/L. Observed effects included inhibition of formulation of the cleavage furrow. Small cells or a total absence of cleavage occurred on exposure to all isomers at concentrations of 16 to 35 mg/L, while incomplete or uneven cleavage was found at exposures of 8 to 15 mg/L.

Table D-10. Effects of Other Ingredients on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	fathead minnow	cyclohexanone	96.2	HSDB 2001
mortality	1/20 LC_{50}[b]	rainbow trout	cyclohexanone	30.3 - 75.7	EPA 2001
mortality	1/20 LC_{50}[b]	rainbow trout	ethylbenzene	14	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	rainbow trout	naphtha (as naphthalene)	0.32 - 1.1	EPA 2001
mortality	1/20 LC_{50}[b]	coho salmon	naphtha (as naphthalene)	0.64	Eisler 1987
mortality	1/20 LC_{50}[b]	rainbow trout	xylene	0.42 - 0.68	Mayer and Ellersieck 1986
survival	predation (erratic swimming, equilibrium, breathing)	coho salmon	xylene	100	Morrow et al. 1975
survival	predation (equilibrium)	rainbow trout	xylene	3.2	Walsh et al. 1977
Migration					
rearing	olfaction (avoidance behavior)	rainbow trout	xylene	0.1	Folmar 1976
rearing	olfaction (avoidance behavior)	coho salmon	xylene	0.2	Maynard and Weber 1981
Reproduction					
success	fertilization (rate, cell cleavage)	cod	xylene	8.0 - 35	Kjorsvic et al. 1982

[a]Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b]Adjusted 24-hour value.

Because of rapid volatilization from water and soil to the atmosphere, chronic exposure to fish is unlikely. In the atmosphere, these compounds are readily degraded, primarily by photochemical processes (WHO 1996, WHO 1997).

D.2.6 Fertilizers

Fertilizers include ammonium nitrate, ammonium sulfate, monoammonium and diammonium phosphate, and potassium nitrate. The following paragraphs provide information of the toxicity of these fertilizers to fish species.

Table D-11 lists relevant assessment endpoints and effect concentrations of the proposed fertilizers to fish species, as identified from the literature.

In water, ammonium nitrate degrades to form ammonium and nitrate ions. In addition, ammonia is oxidized to nitrate by algae and bacteria. In water, the ammonium ion can exist in its ionized form (NH_4^+), and in its un-ionized form as ammonia (NH_3). The equilibrium between these two forms depends largely on pH and temperature. Ammonia demonstrates greater toxicity to aquatic species than does the ammonium ion, and this toxicity increases with decreases in pH and temperature.

Table D-11. Effects of Fertilizers on Fish Species

Assessment Endpoints	Assessment Measures	Species	Fertilizer Component	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	ammonia (as NH_3)	0.11	Arthur et al. 1987
mortality	1/20 LC_{50}[b]	Atlantic salmon	ammonia (as NH_3)	0.0074 - 0.036	Knoph 1992
mortality	1/20 LC_{50}[b]	rainbow trout	nitrate (as NO_3)	2.0 (LC_{48})	Rouse et al. 1999
mortality	1/20 LC_{50}[b]	cutthroat trout	nitrate (as NO_3)	2.0 (LC_{41})	Rouse et al. 1999
mortality	1/20 LC_{50}[b]	rainbow trout	diammonium phosphate	93	Blahm and Snyder 1973
mortality	1/20 LC_{50}[b]	coho salmon	diammonium phosphate	49 - 64	HSDB 2001
mortality	1/20 LC_{50}[b]	bluegill	potassium nitrate	38 - 105	EPA 2001
mortality	1/20 LC_{50}[b]	fathead minnow	potassium sulfate	49.5	EPA 2001
Migration					
NA[c]					
Reproduction					
NA					

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = No data available.

Schuytema and Nebeker (1999a) identified a 10-day NOEC and LOEC for ammonium nitrate in Pacific tree frog tadpoles of 141 and 280 mg/L, respectively, based on decreased length and weight; corresponding values for the clawed toad were 280 and 569 mg/L. In a follow-on study of toxicity to the embryos of the same species, Schuytema and Nebeker (1999b) identified a 10-day NOEC and LOEC in Pacific tree frog embryos of 19 and 39 mg/L, and a 5-day NOEC and LOEC in clawed toad embryos of 19 and 39 mg/L. In an additional study, Schuytema and Nebeker (1999c) identified a 16-day ammonium nitrate NOEC and LOEC for embryos of the red-legged frog of 36.6 and 75.4 mg/L, respectively.

Schuytema and Nebeker (1999a) identified a 10-day NOEC and LOEC for ammonium sulfate in Pacific treefrog tadpoles of 116 and 232 mg/L, respectively, based on decreased length; no adverse effects on length or weight were observed in the clawed toad at the highest concentration tested of 939 mg/L. In a follow-up study, the same investigators (Schuytema and Nebeker 1999b) identified a 10-day NOEC and LOEC in Pacific treefrog embryos of 58 and 110 mg/L, and a 5-day NOEC and LOEC in clawed toad embryos of 24 and 58 mg/L.

D.3 Effects Analysis

Based on the stream concentrations estimated by the risk assessment runoff and drift modeling, and the most sensitive assessment endpoints determined from the literature reviewed (as summarized in Section D.2 above), a sublethal effects risk evaluation was made. Data from the literature were evaluated to determine potential effects on some aspects of survival, migration, and reproduction, with the LOECs listed. From the listed data, the lowest LOEC from each of these three assessment endpoints was selected for the risk evaluation. The selected LOECs are not intended to be definitive of all possible

adverse effects at all life-stages related to survival, migration, or reproduction, but are intended to be the most conservative, representative estimates available.

For each stream at Provolt and Sprague, the highest typical and maximum pesticide concentrations modeled are identified, and are compared to the selected assessment endpoint LOECs. An effects ratio was determined, defined as the estimated pesticide concentration over the sublethal effect level. For example, if the stream concentration of a given chemical is estimated to be 0.003 mg/L, and the concentration of that chemical that affects reproduction is 0.006 mg/L, then the concentration-effect ratio would be 0.5—a moderate risk to the fish. Risks to some aspects of survival, migratory, and reproductive endpoints were determined to be low if the effects ratio was 0.1 or below, moderate if 0.1 to 1.0, and high if 1.0 or greater.

D.3.1 Insecticides and Acaricides

Biological

The risk assessment did not include fate and transport modeling for *B.t.*; therefore, expected concentrations in streams were not quantified. EPA has determined that risks from *B.t.* are minimal to non-existent for non-target aquatic organisms, including endangered species (EPA 1998c) (see Table D-1). The potential risks to the survival, migratory, and reproductive endpoints evaluated for special status species in all surface waters associated with Provolt and Sprague are therefore expected to be low for typical and maximum application scenarios.

Organophosphates

The estimates of risk from organophosphates are presented in Tables D-12 and D-13. These risks may be influenced by environmental factors as previously discussed, such as temperature, pH, hardness, and fish size. Organophosphate compounds tend to strongly bind to organic material. It is likely that runoff from spring and summer rain events will contain significant quantities of organic material, reducing bioavailability of organophosphate insecticides.

Table D-12. Risks of Organophosphates to Special Status Fish at Provolt

		Ditch Segments	Williams Creek	Applegate River
		Highest Estimated Surface Water Concentration (mg/L)[b]		
	typ:	*0*	*0*	*0*
	max:	*0.0000000487*	*0.0000000062*	*0.00000000241*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]		
Survival (0.001)	typ:	0	0	0
	max:	0.000049	0.0000062	0.0000024
Migration (0.01)	typ:	0	0	0
	max:	0.0000049	0.00000062	0.00000024
Reproduction (0.0003)	typ:	0	0	0
	max:	0.00016	0.000021	0.0000080

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-2).

Organosulfites

Potential risks from the organosulfite propargite to the survival and reproductive endpoints evaluated are expected to be extremely low. No information on migratory endpoints are currently available. The estimated effects ratios are summarized in Tables D-14 and D-15. Propargite is proposed for infrequent use, with one application to individual trees between April and October, if needed at all. There is a very low risk to aquatic species under these conditions.

Pyrethroids

For typical applications of pyrethroid insecticides, potential risks to the survival and migratory endpoints evaluated for special status species in all stream segments are low. Risk to reproduction is low in all surface waters modeled for the Provolt Seed Orchard, and in Jump-off Joe Creek and its main tributary at Sprague. See Tables D-16 and D-17.

Table D-13. Risks of Organophosphates to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
	typ:	*0.0000000252*	*0.000000000397*
	max:	*0.00000546*	*0.00000000896*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**	
Survival (0.001)	typ:	0.000025	0.00000040
	max:	0.00055	0.0000090
Migration (0.01)	typ:	0.0000025	0.000000040
	max:	0.000055	0.00000090
Reproduction (0.0003)	typ:	0.000084	0.0000013
	max:	0.0018	0.000030

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-2).

Table D-14. Risks of Organosulfites to Special Status Fish at Provolt

		Ditch Segments	Williams Creek	Applegate River
		Highest Estimated Surface Water Concentration (mg/L)[b]		
	typ:	*0*	*0*	*0*
	max:	*0.00000000817*	*0.00000000657*	*0.00000000345*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**		
Survival (0.008)	typ:	0	0	0
	max:	0.0000010	0.00000082	0.00000043
Migration (NA)	typ:	NA	NA	NA
	max:			
Reproduction (0.028)	typ:	0	0	0
	max:	0.00000029	0.00000023	0.00000012

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-4).
[d]NA = No data available.

Table D-15. Risks of Organosulfites to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
	typ:	*0.000000000801*	*0.0000000000122*
	max:	*0.0000000104*	*0.000000000171*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]	
Survival (0.008)	typ:	0.00000010	0.0000000015
	max:	0.0000013	0.000000021
Migration (NA)	typ:	NA	NA
	max:		
Reproduction (0.028)	typ:	0.000000029	0.00000000044
	max:	0.00000037	0.0000000061

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-4).
[d]NA = No data available.

Table D-16. Risks of Pyrethroids to Special Status Fish at Provolt

		Ditch Segments	Williams Creek	Applegate River
		Highest Estimated Surface Water Concentration (mg/L)[b]		
	typ:	*0*	*0*	*0*
	max:	*0.00000000248*	*0.000000001*	*0.00000000122*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]		
Survival (0.000025)	typ:	0	0	0
	max:	0.000099	0.000040	0.000049
Migration (0.0001)	typ:	0	0	0
	max:	0.000025	0.000010	0.000012
Reproduction (0.000004)	typ:	0	0	0
	max:	0.00062	0.00025	0.00031

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-5).

Table D-17. Risks of Pyrethroids to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
	typ:	*0.0000000228*	*0.00000000176*
	max:	*0.0000000757*	*0.00000000231*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]	
Survival (0.000025)	typ:	0.00091	0.000070
	max:	0.0030	0.000092
Migration (0.0001)	typ:	0.00023	0.000018
	max:	0.00076	0.000023
Reproduction (0.000004)	typ:	0.0057	0.00044
	max:	0.019	0.00058

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-5).

These risk estimates may be influenced by environmental factors, as discussed in Section D.2, such as turbidity and temperature. It is likely that spring and summer runoff will contain significant quantities of organic material, reducing bioavailability of any pyrethroids, and therefore further reducing risk. Since warmer temperatures tend to reduce the toxicity of pyrethroids to salmonids, it is unlikely that toxic effects will exceed those described in the literature. Furthermore, at Provolt, actual risk to reproductive endpoints is unlikely, since pesticide applications would be conducted in spring and early summer months, and it is unlikely that fish will be spawning or emerging from eggs during the time of the proposed applications near these seed orchards.

The ammocoetes of lamprey may spend up to five to seven years living and feeding in fine silt and sand on stream bottoms and so may be exposed to toxics for longer periods of time than juvenile salmonids. Also, lamprey ammocoetes may be more susceptible to uptake of chemicals that bind to sediments such as the pyrethroids.

D.3.2 Herbicides

Risks to special status aquatic species from typical and maximum herbicide applications are expected to be extremely low. Effects ratios are presented in Tables D-18 and D-19. The influence of environmental factors on potential risks to aquatic species appears to be negligible. Increasing temperature, pH, hardness, or differences in multiple life stages of salmonids was shown to increase toxicity values up to two- to six-fold by Folmar et al. (1979) and Woodward (1976). Such increases are still not likely to result in any significant toxicity to the fish in Provolt or Sprague Seed Orchard streams or downstream water bodies.

D.3.3 Fungicide

Typical and maximum applications of the fungicide chlorothalonil at both seed orchards are associated with an extremely low potential for risks to survival and reproductive endpoints evaluated for special status species. No information on migratory endpoints is currently available. The concentration-effects ratios are summarized in Tables D-20 and D-21.

Table D-18. Risks of Herbicides to Special Status Fish at Provolt

	Ditch Segments	Williams Creek	Applegate River
	Highest Estimated Surface Water Concentration (mg/L)[b]		
typ:	*0.000000517*	*0.0000000673*	*0*
max:	*0.00000222*	*0.000000347*	*0.000000000246*
Assessment Endpoint (LOEC - mg/L[c])	**Concentration-Effect Ratio[a]**		
Survival (0.035) typ:	0.000015	0.0000019	0
Survival (0.035) max:	0.000063	0.0000099	0.0000000070
Migration (0.046) typ:	0.000011	0.0000015	0
Migration (0.046) max:	0.000048	0.0000075	0.0000000053
Reproduction (2.0) typ:	0.00000026	0.000000034	0
Reproduction (2.0) max:	0.0000011	0.00000017	0.00000000012

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-7).

Table D-19. Risks of Herbicides to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
	typ:	*0.000000118*	*0.0000000018*
	max:	*0.00000173*	*0.0000000284*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]	
Survival (0.035)	typ:	0.0000034	0.000000051
	max:	0.000049	0.00000081
Migration (0.046)	typ:	0.0000026	0.000000039
	max:	0.000038	0.00000062
Reproduction (2.0)	typ:	0.000000059	0.00000000090
	max:	0.00000087	0.000000014

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-7).

Table D-20. Risks of Fungicide to Special Status Fish at Provolt

		Ditch Segments	Williams Creek	Applegate River
		Highest Estimated Surface Water Concentration (mg/L)[b]		
	typ:	*0*	*0*	*0*
	max:	*0.00000000871*	*0.00000000657*	*0.00000000345*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]		
Survival (0.00049)	typ:	0	0	0
	max:	0.0000017	0.0000013	0.00000070
Migration (NA[d])	typ:	NA	NA	NA
	max:			
Reproduction (0.0065)	typ:	0	0	0
	max:	0.0000013	0.0000010	0.00000053

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-9).
[d]NA = No data available.

Table D-21. Risks of Fungicide to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
	typ:	*0.00000000207*	*0.0000000000314*
	max:	*0.0000000323*	*0.00000000053*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]	
Survival (0.00049)	typ:	0.00000042	0.0000000064
	max:	0.0000066	0.00000011
Migration (NA[d])	typ:	NA	NA
	max:		
Reproduction (0.0065)	typ:	0.00000032	0.0000000048
	max:	0.0000050	0.000000082

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-9).
[d]NA = No data available.

D.3.4 Other Pesticide

Extremely low risks to survival endpoints for special status aquatic species are also predicted for horticultural oil. No information on migratory or reproductive endpoints is currently available. Data are presented in Tables D-22 and D-23.

D.3.5 "Other" Ingredients

Potential risks from "other" ("inert") ingredients in the pesticide formulations for special status species in all surface waters are expected to be extremely low for both typical and maximum applications. These compounds include cyclohexanone, ethylbenzene, naphtha, and xylene. The concentration-effect ratios are summarized in Tables D-24 and D-25. Because these compounds volatilize quickly from water and soil to the atmosphere, actual risks to fish are expected to be lower than the predicted levels.

D.3.6 Fertilizers

Potential risks from typical and maximum fertilizer applications to the survival endpoints evaluated for special status fish species in all surface waters at Provolt are expected to be extremely low. No information on migratory or reproductive endpoints is currently available. At Sprague, typical fertilizer applications have low risk potential, while maximum applications are associated with moderate risks to fish species in Jump-off Joe Creek from ammonia. Risks of sublethal effects to survival are high in the main tributary to Jump-off Joe Creek. Concentration-effects ratios are presented in Tables D-26 and D-27.

Table D-22. Risks of Other Pesticides to Special Status Fish at Provolt

	Ditch Segments	Williams Creek	Applegate River
	Highest Estimated Surface Water Concentration (mg/L)[b]		
typ:	*0*	*0*	*0*
max:	*0*	*0*	*0.000000000568*
Assessment Endpoint (LOEC - mg/L[c])	Concentration-Effect Ratio[a]		
Survival (100) typ:	0	0	0
max:	0	0	0.0000000000057
Migration (NA) typ:	NA	NA	
max:			NA
Reproduction (NA) typ:	NA	NA	NA
max:			

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see section D..2.4).
[d]NA = No data available.

Table D-23. Risks of Other Pesticides to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
	typ:	*0.000000268*	*0.00000000407*
	max:	*0.000000845*	*0.0000000139*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]	
Survival (100)	typ:	0.0000000027	0.000000000041
	max:	0.0000000085	0.00000000014
Migration (NA)	typ:	NA	NA
	max:		
Reproduction (NA)	typ:	NA	NA
	max:		

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see section D.2.4).
[d]NA = No data available.

Table D-24. Risks of "Other" Ingredients to Special Status Fish at Provolt

		Ditch Segments	Williams Creek	Applegate River
		Highest Estimated Surface Water Concentration (mg/L)[b]		
	typ:	*0*	*0*	*0*
	max:	*0.00000000738*	*0.000000008*	*0.00000000311*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]		
Survival (0.32)	typ:	0	0	0
	max:	0.000000023	0.000000025	0.0000000097
Migration (0.10)	typ:	0	0	0
	max:	0.000000074	0.000000080	0.000000031
Reproduction (8.0)	typ:	0	0	0
	max:	0.00000000092	0.0000000010	0.00000000039

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-10).

Table D-25. Risks of "Other" Ingredients to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
	typ:	*0.000000136*	*0.00000000206*
	max:	*0.00000132*	*0.0000000218*
Assessment Endpoint (LOEC - mg/L[c])		Concentration-Effect Ratio[a]	
Survival (0.32)	typ:	0.00000043	0.0000000064
	max:	0.0000041	0.000000068
Migration (0.10)	typ:	0.0000014	0.000000021
	max:	0.000013	0.00000022
Reproduction (8.0)	typ:	0.000000017	0.00000000026
	max:	0.00000017	0.0000000027

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-10).

Table D-26. Risks of Fertilizers to Special Status Fish at Provolt

		Ditch Segments	Williams Creek	Applegate River
		Highest Estimated Surface Water Concentration (mg/L)[b]		
Ammonium	typ:	*0*	*0*	*0*
	max:	*0.0000000408*	*0.0000000611*	*0.00000000247*
Nitrate	typ:	*0*	*0*	*0*
	max:	*0.000652*	*0.0000703*	*0.0000332*
Phosphate	typ:	*0*	*0*	*0*
	max:	*0.000000524*	*0.0000000574*	*0.0000000291*
Survival Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**		
Ammonium (0.074)	typ:	0	0	0
	max:	0.0000055	0.0000083	0.00000033
Nitrate (2.0)	typ:	0	0	0
	max:	0.00033	0.000035	0.000017
Phosphate (490)	typ:	0	0	0
	max:	0.000000011	0.0000000012	0.00000000059

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-11).

Table D-27. Risks of Fertilizers to Special Status Fish at Sprague

		Main Tributary	Jump-off Joe Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]	
Ammonium	typ:	*0*	*0*
	max:	*0.0929*	*0.0023*
Nitrate	typ:	*0.00379*	*0.0000957*
	max:	*0.00427*	*0.0000927*
Phosphate	typ:	*0.00000685*	*0.000000163*
	max:	*0.00138*	*0.0000314*
Survival Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**	
Ammonium (0.074)	typ:	0	0
	max:	13	0.31
Nitrate (2.0)	typ:	0.0019	0.000048
	max:	0.0021	0.000046
Phosphate (490)	typ:	0.00000014	0.0000000033
	max:	0.000028	0.00000064

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-11).

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Appendix E: Public Comments on Draft EIS and BLM Responses

Introduction — NEPA Public Involvement in the Medford District

The Council on Environmental Quality's regulations for implementing the *National Environmental Policy Act* (NEPA) (40 CFR 1500-1508) mandate public participation in the environmental impact analysis process. BLM prepared the Draft EIS and made it available for public review and comment on June 27, 2003. The availability of the Draft EIS was announced as follows:

- A Notice of Availability was published in the *Federal Register* on June 13, 2003.
- Notices were placed in three local newspapers: *Medford Mail Tribune* (June 8, 2003); *Grants Pass Daily Courier* (June 13, 2003); and *Ashland Daily Tidings* (June 10, 2003).
- Copies of the Draft EIS were sent to two local libraries, the Medford Public Library and the Grants Pass Public Library.
- Postcards offering to send a hard copy or CD of the Draft EIS upon request were sent to the 27 agencies and 425 members of the public on the Draft EIS mailing list.
- Electronic copies of the Draft EIS were placed on the Medford District website for viewing or downloading, at http://www.or.blm.gov/medford/planning/medpest_eis_main.html
- Copies of the Draft EIS were available in hard copy and CD at the BLM Medford District Office and the Provolt and Sprague Seed Orchards offices.

The public comment period ended on August 25, 2003.

BLM held meetings in an open house format to present the findings of the Draft EIS and invite public comments. The meetings were held at Sprague Seed Orchard on July 14, 2003, and at Provolt Seed Orchard on July 15, 2003, from 1:00 to 3:00 p.m. and 5:00 to 7:00 p.m. at both locations. There were no attendees at either meeting at Sprague, and one attendee during the early session at Provolt.

Content Analysis

BLM received very few comments on the Draft EIS. One verbal comment was received during the public meetings and four written comments were received during the public comment period. The BLM EIS team reviewed all public comments. However, due to the small number of comments received, no statistical analysis of the commentors' demographics and nature of comments was performed.

There were no commentors at the Sprague public meetings. There was one commentor at the Provolt public meetings, an individual who identified himself as a volunteer at Provolt and a pest control retiree. Written comments were received from two Federal agencies, an individual representing herself and two organizations, and a private firm. Table E-1 lists the commentors and the overall focus of their comments. Of the four written comments, two were sent to BLM after the comment deadline of August 25, 2003, but have been considered in preparing the Final EIS.

Table E-1. Comment Summary

Tracking Number	Commentor	Format and Date	Focus
M1	Gordon Nunnally Volunteer at Provolt Seed Orchard Central Point, OR	Provolt Public Meeting 7/15/03	Support for Alternative B and the IPM approach to pest control
M2	Michael P. Tehan National Marine Fisheries Service (NOAA Fisheries) National Oceanic and Atmospheric Administration Portland, OR	Letter dated 8/13/03, received 8/20/03	Suggestions for additional analysis, monitoring, and protection measures for anadromous fish species
M3	Judith Leckrone Lee Manager, Geographic Unit Region 10, U.S. Environmental Protection Agency Seattle, WA	Faxed letter dated 9/10/03, received 9/10/03	Support for Alternative B, pesticide safety, IPM for specific diseases, additional technologies, Port-Orford-Cedar management,. pesticides listed in a recent Western District Court decision
M4	Jan Wroncy Individually and representing Coast Range Guardians and Canaries Who Sing Eugene, OR	Letter dated 8/25/03, faxed 8/27/03	Support for Alternative C, opposition to use of pesticides, request to exclude *B.t.* from Alternative C, statement that impacts from pesticides are underestimated and would affect salmon, recommended no use of fertilizers to decrease need for pesticides
M5	Brian A. Schlaefil, Area Chief Forester Boise Building Solutions, Western Oregon Timberlands Medford, OR	Letter dated 8/25/03, received 8/25/03	Support for Alternative B

[1] Revised to be named Non-Pesticide Pest Management for Final EIS in response to comment M4-2.

Of the five commentors, three supported the selection of Alternative B (IPM with Environmental Protection Emphasis—the proposed action and preferred alternative) and one recommended that Alternative C (Non-Chemical Pest Management[1]) be selected. One commentor expressed no preference for a selected alternative, and limited comments to suggestions for changes to the details of Alternative B to further protect threatened salmonid species.

Comments and Responses

Copies of each comment on the Draft EIS are provided at the end of this appendix. Each item (transcript or comment letter) was assigned an identification number (M1 through M5) that appears in the upper right-hand corner of the first page of the comment letter or transcript. Because some commentors made more than one comment, each comment was also assigned an identification number. Separate comments within the transcript or letter are numbered along the left margin of the item, and are identified using an alphanumerical code consisting of the item's identification number and the individual comment number. For example, the first separate comment in item M2 is labeled M2-1, the second separate comment is M2-2, and so on. The meeting transcript is presented first, followed by letters from Federal agencies and then by other comments.

Table E-2 presents BLM's responses to each comment, including references to sections of the EIS that were changed, as appropriate. Excerpts from each numbered comment were copied verbatim from the transcript or comment letter and presented in Table E-2 to maintain proper context.

Table E-2. Comments and Responses

Comment Number	Comment	Response
Gordon Nunnally, Provolt Public Meeting		
M1-1	I'm glad to see you are moving towards this Alternative B. Hopefully you will get the okay to follow it up. I understand that some years they lose as much as 50 percent of the production to pests in operations for profit. That would not be acceptable. *--and--* But I do think IPM is the way to go. It postpones resistance, which, unfortunately, seems to happen with many pesticides. *--and--* Looks like Alternative B is the way to go in my opinion.	Support for Alternative B (BLM's proposed action and preferred alternative) is noted.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
Michael P. Tehan, Oregon State Director, Habitat Conservation Division National Marine Fisheries Service (NOAA Fisheries), Oceanic and Atmospheric Administration, Portland, OR		
M2-1	The use of monitoring results related to adaptive management is an important component of the preferred alternative. The draft EIS refers to the importance of integrating monitoring data with future management: "....[adaptive management] would provide a relationship between monitoring results and the management that is planned for the future." (BLM., draft EIS page b-4). NOAA Fisheries agrees that using monitoring data to adjust subsequent applications of compounds is vital to a multi-year approach, and presents the following guidance as a proposed structure to achieve this. The EIS should be enhanced by describing the integration of monitoring data that will inform annual application variables as described in the tables of Chapter 2 of the draft EIS. Annual reports should be paired with new proposed application schedules for the upcoming year, which can be modified if necessary by the previous years monitoring results. These yearly reports would facilitate multi-year consultation that accounts for the variability of potential monitoring results, compounds planned for use and application location, methods, and timing. In summary, the annual report should include: (1) Monitoring results that synthesize the relative effectiveness of the application methods and timing to avoid effects to aquatic species; (2) a literature review of any new studies that illuminate effects (from compounds used on the orchards) to aquatic life that are not accounted for in the original EIS; (3) a review of any new best management practices that may further reduce risk to aquatic species; (4) a new annual application schedule that details the type, location, timing, amounts and methods to reduce or avoid effects from compound application, and (5) a new effects analysis, as appropriate, that assesses whether any of the above factors result in effects to aquatic species not analyzed in the EIS and biological opinion (Opinion). If the new annual application plan is within the range of effects analyzed in the Opinion, NOAA Fisheries will indicate in writing that a new section 7(a)(2) or MSA consultation is not necessary, therefore continuing coverage of the Incidental Take Statement of the Opinion for another year. NOAA Fisheries would issue the original Opinion for five years, with annual reports informing whether subsequent Opinions or MSA consultations are necessary for each orchard. These provisions would ensure that the BLM and NOAA Fisheries utilize best available scientific and commercial data to minimize and avoid adverse effects to listed species within the action area.	In the Biological Assessment prepared by BLM that formally documents the agency's consultation with NOAA under Section 7 of the *Endangered Species Act*, a procedure for preparing the requested annual reports and submitting them for NOAA review is described. Section 1.4.2 has also been revised to update the description of the consultation process.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M2-2	The monitoring section only refers to pesticides. Monitoring should be conducted for fertilizers as well.	The monitoring plan described in Appendix B of the EIS has been modified to include fertilizers.
M2-3	The EIS should provide a definition of "high risk ground applications" that will be targeted for applications.	This comment refers to monitoring for drift. The reference to "high risk ground applications" in Appendix B of the EIS has been revised to specify the applications that would be subjects for drift card monitoring. In keeping with the adaptive management approach, drift card monitoring may be adjusted (via the annual reports submitted to NOAA) based on the findings of monitoring activities to date.
M2-4	Monitoring frequency should be described for surface water sampling events	The description of monitoring in Appendix B of the EIS has been extended to include more information on monitoring activities.
M2-5	Within validation monitoring, a definition of "significant rainfall events" should be provided.	This sentence in Section B.1.5.3 has been revised to specify that the field runoff collection chamber will be sampled during the first overland flow event following an application. Subsequent sampling of this site will depend on the results from this initial sampling.
M2-6	Fertilizer application should occur at agronomic rates as defined the amount of nutrients applied to vegetation equal the anticipated biological uptake of the plants. This eliminates excess nutrients from polluting surface or ground waters.	The objective of the orchards' fertilization program, using the results of the annual foliar and soils survey results (referenced in Section 2.2.2.5 of the EIS) and a fertilizer application computer program, is to provide nutrients to only zero deficiency for the crop trees in the orchards.
M2-7	Proposed buffer widths for each compound for the orchard unit, as appropriate, should be included in the EIS. Given the vagaries of application conditions and timing, keeping the buffer widths fixed for the term of the consultation is desired by NOAA Fisheries. At the end of the consultation term and subsequent to additional consultation, the opportunity of reduced buffer widths could be discussed. This would take advantage of a larger data set from monitoring, and generally lead to more informed decisions on buffer widths.	In response to this request, a table has been added to Section E.6.4 of the BA that provides the buffer widths for all orchard units adjacent to surface water. If monitoring data available to date at any point in the IPM program lead BLM to determine that reduced buffer widths could be acceptable, a proposal to reduce buffer widths would be offered by BLM via the annual reporting to NOAA (described in Section E.1.5 of the BA). Resolution of the request would be part of the ongoing coordination required by NOAA for multi-year consultation under Section 7 of the ESA.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M2-8	To the greatest extent possible, the potential effects to aquatic life from multiple compound use within the action area should be described.	Section E.8.2 of the BA provides a discussion of the potential for synergistic effects from the proposed pesticides to aquatic species, in response to NOAA's request.
M2-9	NOAA Fisheries prefers that extensive prescribed fire not occur within riparian areas. In cases where the BLM prefers to utilize prescribed fire within riparian areas, the extent should be limited and management methods described that facilitate native vegetation regrowth, and prevention of exposed soils, etc. The EIS should identify these site specific provisions.	The only areas in which prescribed fire may be used that could be considered riparian areas are along irrigation ditches as stated in Section 2.2.2.3. A protection measure addressing NOAA's concern has been added to the proposed action (and all other alternatives); see Section 2.3.1.
M2-10	An assessment of sublethal effects should be included for the irrigation ditch segments within the Provolt Orchard.	The requested assessment has been added to Appendix D and Section 4.7 of the Final EIS. A statement indicating that coho salmon were recently observed entering Laurel Hill Ditch has been added to Section 3.7.
M2-11	As suggested in the draft EIS, the irrigation ditches within the Provolt Orchard offer an additional vector for compound introduction to surface waters. These irrigation ditches have grass species on each bank that offer reduced preventative function for the introduction of compounds from spills, drift and overland surface water flows relative to more diverse vegetative communities. In the event of compounds reaching the irrigation ditches, return flows to salmon bearing waters could adversely effect aquatic life. While mixing and dilution will occur, the relatively stable hydraulic characteristics of the ditches may prevent significant dilution. The BLM should plant vegetation (i.e. shrubs) that offer an increased measure of protection from contamination, or tight-line the irrigation ditches which would virtually eliminate runoff potential. In addition, shrubs or tight-lining would prevent return flows from heating up and transpiration loss that adversely effect listed species. An added benefit from tight-lining would be the anticipated elimination of setbacks buffers, in turn increasing pest management effectiveness.	BLM has thoroughly evaluated NOAA's recommendations for planting additional vegetation or tight-lining the irrigation ditches at Provolt. However, neither of these actions are anticipated at this time, due to (1) modeling predictions that drift is unlikely to reach the ditches from treated areas, even without a two-tree-row additional buffer as is included in the limitations incorporated into the preferred alternative; (2) a need to maintain airflow patterns in the seed orchards to prevent/reduce frost damage, therefore precluding vegetation of any significant height other than the seed trees; and (3) requirements by the irrigation ditch company regarding the flow rates, maintenance standards, and structural integrity of the ditch banks (vegetation roots affect bank structure) for these irrigation ditches that provide essential water for downstream agricultural operations.
M2-12	Enhanced buffers adjacent to Williams Creek and the Applegate River near orchard units 15, 16, and 17 (depicted in figure 2.1-1of the draft EIS) would also reduce potential contamination through more diverse and wider vegetative communities. Given the orchards sensitivity to native conifers adjacent to production conifers, a mix of native shrubs and willows should be planted.	Please see response to previous comment.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
Judith Leckrone Lee, Manager, Geographic Unit U.S. Environmental Protection Agency, Region 10, Seattle, Washington		
M3-1	U.S. EPA supports the direction and intent of BLM's Preferred Alternative because it emphasizes environmental protection in the management of pests and seed orchards.	Support for Alternative B noted.
M3-2	Based on our review, we have rated the DEIS, EC-2 (Environmental Concerns - Insufficient Information). The rating and a summary of our comments will be published in the *Federal Register*. Our detailed comments and a summary of the rating system we used in our evaluation of this DEIS are enclosed for your reference.	BLM notes EPA's rating. Responses to specific comments are provided below.
M3-3	We recommend that the FEIS discuss additional pesticide safety issues, consider additional IPM methodologies for potentially new orchard diseases, and address the relevancy of a concurrent BLM Draft Supplemental Environmental Impact Statement (Management of Port-Orford-Cedar by Southwest Oregon) which BLM is working on that may impact proposed activities by the four seeds orchards. We also recommend that the FEIS discuss how a recent Western District Court decision may affect the Action Alternatives, especially the Preferred Alternative.	See responses below to detailed EPA comments that are summarized in this paragraph, which appears in EPA's transmittal letter.

Comment Number	Comment	Response
M3-4	List of Proposed Pesticides U.S. EPA recommends that the list of proposed pesticides for use in the seed orchards be wisely considered for potential impacts to worker safety and non-target species. Many of the proposed insecticides identified in the DEIS are older, non-specific pesticides which must be treated with care to minimize damaging non-target organisms and worker safety.	The proposed pesticides are those that have been demonstrated to be effective against potential seed orchard pests and that are labeled for such use under FIFRA by EPA. Additional pesticides that are either not currently available or not currently appropriately labeled may be considered for use by BLM in the future, as discussed in Section 2.4 of the EIS. This discussion also provides details on the procedures to ensure NEPA compliance should BLM propose to implement pest control with newly available chemicals or technologies. BLM prepared a detailed human health and non-target species risk assessments as part of the EIS process. A summary of the risk assessment is provided as Appendix C to the Draft EIS. The full text of the risk assessment is online at EIS web site at http://www.or.blm.gov/medford/planning/medpest_eis_main.html, and was included on the Draft EIS CD-ROMs that were sent to all requesting parties on the mailing list. The results of that risk assessment were used to come to the conclusions regarding worker (and public) health impacts from pesticide exposure in Section 4.6 of the Draft EIS, and non-target species impacts in Section 4.7. The pesticide applications that resulted in unacceptable risks to human health or nontarget species were used to develop Alternative B, BLM's proposed action and preferred alternative, as described in Section 2.3.3 of the Draft EIS.
M3-5	Some [proposed pesticides] (e.g. picloram or triclopyr) are know to be highly soluble and under some conditions (rainfall, soil type, amount used) could contaminate groundwater.	The detailed risk assessment (described in response to previous comment) included site-specific modeling of potential groundwater contamination from all proposed pesticides, including picloram and triclopyr. Although some of the pesticides may be mobile in soil, the concentrations predicted by the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model were far below those that would pose any risk to an individual using the underlying aquifer for all drinking water. See Sections 3 and 6 of the referenced risk assessment for modeling details and risk conclusions, respectively.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M3-6	Some [proposed pesticides] may be reasonably safe to humans but highly toxic to wildlife. For example, diazinon is highly toxic to some birds, and there is recent research suggesting that they impair salmonid olfaction functions at very low levels.	The detailed risk assessment (described in response to comment M3-4, included risks from diazinon and all other proposed pesticides to wildlife, including several bird species representing a range of habitats and feeding patterns, and salmonids at or near the seed orchard. In addition, a sublethal effects analysis was conducted for special status salmonid species, and was provided as Appendix D to the Draft EIS. Conclusions from these assessments are summarized in Section 4.7 of the EIS, and were considered in developing the limitations that differentiate Alternative A from Alternative B. Table D-2 in Appendix D and the associated text discussion include information on impacts of diazinon exposure on salmonid olfactory function.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M3-7	We recommend that BLM access and run the Natural Resource Conservation Service model, WIN-PEST, for its fields and the planned pesticides as a preliminary analysis of environmental and human risk potential. This modeling program is available to anyone via the web at the NRCS website www.wcc.nrcs.usda.gov/pestmgt/winpst.html. The program needs to have the user input their field soil type(s) (the entire U.S. database is available within this program, the user only needs to know the map unit code or soil series from a soil survey map of their area) and then select the pesticides that will be used on that field. There are a few additional variables to provide including probability of rain following application, pesticide rates (low, med, standard), soil verses foliar applied, broadcast verses banded application as well as others. The model will run a soil type by pesticide interaction and produce a series of human health and aquatic hazard quotients (Extra High risk to Very Low and categories in between) based on the ability of the soilxpesticide to leach to groundwater or runoff via sediment or soil solution. There are many NRCS field offices with staff trained on this program. Also, Oregon State University just received a grant to train technical service providers on using the tool (Paul Jepson and Dan Sullivan at OSU).	As described in the response to comments M3-5 and M3-6, BLM conducted very detailed, site-specific fate and transport modeling of all the proposed pesticides as part of the risk assessment that was part of the EIS process. The parameters identified in EPA's comment are among the dozens of site-specific soil, climate, and pesticide inputs that were used. Please refer to Section 3 of the risk assessment for a detailed description of the GLEAMS model and input parameters. Since very detailed output was required by BLM to identify and manage risks, a detailed risk assessment approach (as opposed to a screening-type model such as WIN-PEST) was selected for use. BLM also notes that the fate and transport component of WIN-PEST relies on averaged results that were developed by USDA using the GLEAMS model. The output from the risk assessment GLEAMS modeling was used to estimate groundwater and surface water concentrations, which were compared to toxicity values identified through a detailed literature review, to estimate risks to both humans and nontarget species from off-site pesticide movement. Please see the referenced risk assessment for extensive detail on the methodology and conclusions. A summary of the risk assessment was also provided as Appendix C to the Draft EIS. The risk assessment conclusions were used to support the risk conclusions presented in Sections 4.6 and 4.7 (human health and nontarget species, respectively) in the Draft EIS.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M3-8	Root Rot (*Phytophthora*) on Port-Orford-Cedar We recommend that the FEIS explore the potential of using antagonistic fungi, a constituent of finished compost called a fungistat, as a tool for managing and preventing Phytophthora within seed orchard operations. A fungistat is a compound that inhibits fungal growth or sporulation but does not cause death. A fungistat keeps the disease from progressing once it is in the tree, but does not necessarily cure the tree, hence repeated applications are necessary. Research in California has shown some composts enhance biological activity of antagonistic fungi that attack *Verticillium* and *Phytophthora*. Since we did not see a reference in the DEIS to fungistats, we are suggesting that the FEIS investigate and disclose the potential of using fungistats as a means to mitigate any outbreak of *Phytophthora* infections within a seed orchard's stock of Port-Orford-Cedars.	Investigation into this topic and consultation with BLM and Forest Service experts revealed that fungistats may offer some potential for disease control at the seed orchards, although their initial use would be experimental, since no field data on efficacy in seed orchards are available. Should the need arise and the technology appear possibly appropriate at the time, BLM may consider a field trial at the seed orchards. In this case, the procedures listed in Section 2.4 of the EIS would be followed, as they would be in all other cases in which a promising new technology becomes available.
M3-9	Sudden Oak Death (*Phytophthora ramorum*) Sudden Oak Death (SOD) is damaging pathogenic fungus-like algae that invades the bark killing the entire tree or portions of the tree. SOD is spreading across west coast states and its known host species is also expanding. This pathogen, first detected in California in 1995, has advanced northward into southwestern Oregon. According to announcements in early 2001 from Oregon Department of Agriculture and Forestry, the U.S. Forest Service, and BLM, SOD had invaded southwestern Oregon. In addition, SOD can infect many different genuses and species. In 2002, University of California researchers confirmed that coastal redwoods (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii* var. menziesii) are host species for the SOD pathogen. The confirmed host species list includes 20 broadleaf species involving 12 different families. A tentative host list is even considerably longer. The potential impact of this pathogen on the seed orchards' tree stocks should not be overlooked. On most non-oak hosts, SOD primarily attacks foliage or stems resulting in non-lethal damage to plants, and it could impact seed production. On Douglas firs for example, the pathogenic infestation causes cankers on small branches, wilting of new shoots, and some dieback of branches and needles (University of California). Furthermore, with the understanding that oak stands are known to exist outside some of the seed orchard areas, the FEISs should address the potential transfer of this pathogen from outside sources into the seed orchards.	In response to this comment, a discussion of sudden oak death and BLM's compliance with current local, state, and Federal quarantine/other regulations has been added to Section 1.4.2 of the Final EIS. At the time the Final EIS went into publication, SOD was confined to two locations in Oregon, neither of which is near the seed orchards. BLM will monitor information bulletins from the Oregon Department of Agriculture and follow all relevant recommendations. Since the locations and containment of this disease, and recommendations for addressing it, are likely to continue to change over the life of the seed orchard IPM program, BLM has not committed to a specific course of action in the event that any seed orchard trees are threatened by SOD. If the planned response does not fall within the alternative selected by the ROD for this EIS, the procedures in Section 2.4 will be followed to ensure NEPA compliance for any proposed activities.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M3-10	<u>*Phytophthora ramorum and lateralis*</u> The FEIS should disclose how BLM will address the potential for spread of the pathogens *P. ramorum and P. lateralis* through the movement of seedlings, or by infested plant parts such as firewood, wood chips, mulch, leaves, or soil. Oregon Department of Agriculture has reported that researchers have found that *P. ramorum* moves with wood, leaves, surface waters (i.e., streams) and soil. The role of insects and birds in spread of *P. ramorum* disease is also under investigation. The California Department of Agriculture quarantine regulates the movement of bark, bark chips, and mulch. Since the DEIS proposes to dispose of wood from trees by selling it as firewood, be advised that firewood is another potential source of the spread of *P. spp.*, particularly *P. lateralis*. In addition, tractors, to a lesser extent, have considerable potential for moving the spoils within soil from one area to another. These pathogens can also be spread through watershed via streams from spores in water since the spores can readily adhere to eroded soil particles. Finally, we are aware that some organizations have established protection zones along hilltops to prevent the spread of *P. lateralis* downstream in the watershed.	In response to this comment, BLM has added information on measures in place that ensure diseased seedlings are not transported from the greenhouse at Sprague to offsite locations. Section 2.1.2 has been clarified to state that only routinely pruned wood from healthy trees would be considered for sale as firewood. BLM did not intend to imply that wood from diseased trees would be disposed of in this manner. As stated in response to the previous comment, information has been added to Section B.2 of Appendix B specifically addressing BLM's monitoring activities for sudden oak death.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M3-11	We suggest that the FEIS consider using parasitoids as another viable biological control methodology of unwanted orchard pests. Insect parasitoids have an immature life stage that develops on or within an insect host, ultimately killing the host species (Biological Control: A Guide to Natural Enemies, Cornell University). Parasitoids can be the dominant and most effective natural enemy of some pest insects, but their presence may not be obvious because parasitoid adults are small and often overlooked. The parasitoid larva inside a cone or seed may look similar to other pest species and could be incorrectly identified as a pest. Under traditional cultural methods, a seed orchard often will have limited sources of available pollen (for egg production) and nectar (for food energy). In these circumstances, parasitoid activity may be naturally low, but could be enhanced with the addition of plants that would provide low-growing flowers for easy parasitoid access. It may be possible to find suitable flowers that would provide nectar and pollen sources without creating additional problems such as increasing fire danger. It may also be possible to monitor parasitoid activity when a subsample of cones are dissected and checked for the presence of seed infesting insects prior to harvest.	While parasitoids are certainly highly likely to contribute to control of seed and cone pest insects in western Oregon seed orchards, the exact nature and degree of control they provide is so poorly understood that research would be required before nectar and pollen sources in BLM seed orchards were increased as a method of controlling seed and cone pests. No research identified by BLM supports either of the commentor's implied statements that (a) parasitoid activity is capable of providing a significant level of control in seed orchard situations, or that (b) a paucity of pollen and nectar sources currently limits parasitoid activity in these seed orchards. The seed orchards contain significant inclusions of natural vegetation and are bordered by unsprayed fence rows and areas of natural forest. In a study conducted by a Forest Service entomologist in the region, many individuals were recovered of wasp species that likely are parasitoids from Douglas fir cone rearings, evidence of an active parasitoid presence in the current seed and cone insect populations in western Oregon. Although it is conceivable that there would there have been more parasitism if there were flowers planted throughout the seed orchards, many basic questions need to be answered before effective management actions could be designed, namely: What parasitoid species prey upon the major seed and cone insect pests in the region? What species of plants do they feed and nectar upon? At what distance from nectar and pollen sources do these particular parasitoids become limited and lose their effectiveness? What is the current level of parasitoid populations in Pacific northwest seed orchards? Is the existing distribution or abundance of pollen and nectar supplies limiting populations of parasitoids in PNW seed orchards? Given these uncertainties, it is the seed orchard's current position that planting flowers throughout the orchard specifically for the purpose of controlling seed and cone insects could not offer a viable management strategy without first conducting scientific studies to provide a factual basis for such action. As for monitoring parasitoids by visual observation during cone dissection, this would be difficult and largely inaccurate. While some parasitoids develop on the bodies of their hosts, others develop inside their hosts and don't emerge until the host has died. Accurate assessment of parasitoid levels would require rearing

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M3-12	We suggest that the FEIS explore the practice of attract-and-kill technology as exemplified by pheromone traps within seed orchards. Pheromone traps utilize chemical attractants which can be used to monitor the presence of certain pest species. While we understand that numbers of individuals captured are not directly related to damage levels in a field, traps can be monitoring tools to detect the presence of specific pests thereby alerting the manager so that appropriate action(s) can be more precisely timed. While the technology is still incomplete, there is some value in using pheromone traps as additional tools in the proposed IPM program.	Pheromone traps are included in the proposed action and all alternatives under the category "Other Control Methods." See Sections 2.2.2.5 and 2.3 of the EIS.
M3-13	<u>Regarding the 54 Pesticides Cited in Washington Toxics Coalition, et al. vs. U.S. EPA</u> BLM should be aware of recent a Western District Court decision (Washington Toxics Coalition, et al. vs U.S. EPA; Western Dist. of Washington at Seattle, Civ. No. C01-132C) which may result in use restrictions of 54 pesticides on federally-listed endangered and threatened salmonids. The court case identified 54 difference pesticides (herbicides, insecticides, and fungicides) of concern. The FEIS should evaluate how this Court decision may affect the Preferred Alternative, including pesticide use near salmonid-bearing waters within the project areas.	The Draft EIS included a discussion of the referenced decision in Section 1.4.2. The consultation between BLM and NOAA, culminating in the issuance of NOAA's Biological Opinions for the action proposed in this Final EIS (see Appendix F), has resolved this issue as it relates to BLM's integrated pest management program at Provolt and Sprague Seed Orchards.
M3-14	<u>Agency Management and Preservation of Port-Orford-Cedar</u> We recommend that the FEIS disclose how BLM will manage and preserve the Port-Orford-Cedar both at the seed orchard scale and across the landscape with which this unique species lives. BLM is involved in two separate yet connected NEPA processes: these three EISs and another concurrent NEPA process for the management of Port-Orford-Cedar in southwestern Oregon (*Draft Supplemental Environmental Impact Statement, Management of Port-Orford-Cedar in Southwest Oregon*). Port-Orford-Cedar is an important tree species of south western Oregon and northern California both for its lumber quality and its functions within regional forest dynamics and processes. Unfortunately, root rot disease (*Phytophthora*) referenced above has caused and is continuing to cause concern for the management and preservation of this tree species. For continuity of agency management and preservation activities, we strongly recommend that the FEIS for the four seed orchards should disclose their contributing part to protect this valued tree species.	Management and preservation of Port-Orford-cedar at locations other than at the seed orchard is outside the scope of this EIS, which is limited to seed orchard pest management. The proposed IPM program is intended to protect Port-Orford-cedar trees at the seed orchards from insects or disease, along with all other trees that are preserved or managed for cone production at the seed orchard. Port-Orford-cedar preservation concerns not related to pest management on trees at the seed orchard are outside the scope of this EIS. BLM will follow all recommendations contained in the ROD for the Port-Orford-cedar management EIS.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M3-15	Improved Cartographic Information We recommend that all the FEISs improve their cartographic information on illustrating the extent and location of both perennial and ephemeral waterbodies (streams, rivers, wetlands, ponds) and cartographically present the permanence or seasonality of these systems so that appropriate prescriptions and land management allocations are more easily understood by land managers, project reviewers and the general public. We recommend a consistent format of cartographic information among the EISs on water resource information. As a suggestion, Figure 3.4-1 on page 3-7 in the IPM, Travis Tyrrell Seed Orchard DEIS provides the best presentation of the extent and location of perennial and ephemeral streams in the project area. Also, Figure 3.4-1, in the IPM, Water H. Horning Seed Orchard, provides adequate presentation of the extent and location of wetlands within the project area.	Figures 3.4-1 and 3.4-2 have been revised in response to this comment. There are no wetland areas at Provolt or Sprague.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
Jan Wroncy, individually and representing Coast Range Guardians and Canaries Who Sing		
M4-1	On my own behalf and on behalf of the Coast Range Guardians and Canaries Who Sing, I urge you to adopt Alternative D - Non-Chemical Pest Management for the Tyrrell Seed Orchard; Alternative D - Non-Chemical Pest Management for the Horning Seed Orchard; and Alternative C - Non-Chemical Pest Management for the Provolt and Sprague Seed Orchards. *--and--* Therefore, the BLM should adopt the Non-Chemical Pest Management Alternative....	Support for Alternative C is noted. In the Final EIS, Alternative B remains BLM's proposed action and preferred alternative. However, the commentor's request will be considered in selecting the alternative to be implemented by BLM, which will be documented in the Record of Decision. Should BLM select Alternative B, non-chemical methods of pest control would continue to be available. The IPM approach for any specific pest problem incorporates the best-suited method that has minimum impact on the environment and on people, as described in Section 2.2.1.
M4-2	However, the Non-Chemical Pest Management should also include in the prohibited list, the biological control method of using a bioinsecticides, such as Bacillus *thuringiensis* – also known as Bt (formulated as Dipel, Foray 48B, Deliver). Bt formulas are PESTICIDES and do contain CHEMICALS (other ingredients, not necessarily biologically or chemically inert). Dipel, Foray 48B, and Deliver are regulated by the Federal Pesticide law and as such should be included in the Non-Chemical Pest Management list. *--and--* The Bureau of Land Management is ignoring the fact that Deliver, Dipel, Foray 48B (all trade names of pesticide formulas) formulations of Bacillus thuringiensis (Bt) are in fact PESTICIDES, and are, as such, regulated by the Environmental Protection Agency (EPA) as pesticides under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and under State Pesticide Laws. Also formulas of Bt also contain chemicals serving various purposes in the formula. Thus Bt pesticides are both biological pesticides and chemical pesticides. Therefore Bt and other biopesticides should be included in the list of prohibited substances under the Non-Chemical Alternative. *--and--* Therefore, the BLM should ... add to the list of prohibited substances, the biopesticides such as Bacillus *thuringiensis* pesticide formulas.	In the Draft EIS, BLM included the biological insecticide *B.t.* with all of the other biological control methods that would be available for use under Alternative C. However, in response to this comment, BLM has added *B.t.* to the list of pest control methods that would be excluded under Alternative C. To accurately describe its revised content, Alternative C has been renamed Non-Pesticide Pest Management (instead of Non-Chemical Pest Management) in the Final EIS.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M4-3	Additionally, Bacillus thuringiensis itself has been shown to have human health impacts as well as environmental impacts. *--and--* Additionally Bt and other biological agents do have both human health concerns and environmental impacts which must be thoroughly analyzed, and fully revealed. See appeal of Forest Service aerially spraying of Bacillus Thuringiensis in the Alsea Watershed this Spring, attached herein as Attachment F.	No scientific data were provided to support the commentor's assertions. However, in response to this comment, BLM has included additional details in the Final EIS in Sections 4.6 and 4.7 on the evaluation of the potential for *B.t.* to cause human health and nontarget species effects as a result of the proposed action or alternatives. The expanded discussions, further documenting BLM's thorough review of the potential human health and ecological effects of *B.t.*, conclude that no significant impacts are expected. The referenced attachment was not included with the commentor's submission.
M4-4	I appealed the decision to aerially spray esfenvalerate (ASANA) by the BLM at the Tyrrell Seed Orchard but have not received notification of a decision from the Interior Board of Land Appeals (IBLA) yet. The decision by the IBLA may impact the final Environmental Impact Statements for the Tyrrell, Provolt, Sprague, and Horning Seed Orchards. I have attached the comments, protest, and some of the appeal documents I submitted on the Tyrrell Seed Orchard aerial spraying of Esfenvalerate (ASANA) in April of 2003. See Attachment A – Comments; Attachment B – Protest; Attachment C – Appeal Statement of Reasons; Attachment D – Objections to Mootness; Attachment E – Answer to BLM's Motion to Dismiss.	The referenced attachments were not included with the commentor's submission. Notwithstanding this omission, the spray project to which these documents apply was completed at Tyrrell Seed Orchard in 2003. Should any future decision be rendered by the IBLA in regard to that case, it will be considered for relevance to the Medford District's proposed IPM program, and BLM will respond appropriately.
M4-5	The issues of compliance with the National Environmental Policy Act (NEPA), the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Clean Water Act (CWA), the Endangered Species Act (ESA) and other applicable laws apply also to the present Draft Environmental Impact Statements for the Tyrrell, Provolt, Sprague and Horning Seed Orchards.	BLM is required to comply with all of the cited laws and their implementing regulations, and to coordinate as needed with the responsible agencies to address specific resources. BLM's proposed IPM program meets these requirements, as will any specific activities conducted under the selected alternative.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M4-6	The listed chemicals proposed for use have far more serious health and environmental effects than indicated by the Risk Assessments. Included in these comments are the following articles available from the Northwest Coalition for Alternatives to Pesticides (NCAP) located on NCAP's website: http://www.pesticide.org. *At this point, the commentor included a list of 17 pesticide fact sheets available from the NCAP website.*	BLM conducted a thorough review of the toxicity, environmental fate, and ecological effects of the proposed pesticides, using agency-accepted or peer-reviewed literature. Every health toxicity endpoint used in the quantitative risk assessment reflects a scientific consensus from EPA or, in the absence of such, criteria from the World Health Organization or Food and Agriculture Organization of the United Nations. All ecotoxicity endpoints reflect the greatest level of toxicity to the most sensitive relevant species from agency-accepted or peer-reviewed literature. In reviewing the fact sheets referenced in this comment, BLM found that many of the citations that appear in the referenced NCAP fact sheets are included in BLM's risk assessment as well. Although the referenced fact sheets summarize effects observed in a laboratory and field tests from a wide range of sources for each pesticide, in many cases the summaries do not provide the doses or concentrations at which these responses were observed, limiting their usefulness in conducting a quantitative risk assessment, nor do they provide any recommendations on values for use in a risk assessment (such as reference doses). BLM believes that the existing risk assessment reflects accepted data and methodology, and has made no changes. *Note:* The commentor referenced the pesticide "Chromated Copper Arsenate" (CCA) and included a link to an NCAP fact sheet on that chemical. CCA is not, and has never been, proposed for inclusion in the IPM program at Provolt and Sprague.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M4-7	Note that "inert" ingredients are NOT INERT. See articles on "inerts" at: http://www.pesticide.org/inertsreport.pdf [and] http://www.pesticide.org/ActiveInertsRpt.pdf. Additionally, there has been favorable rulings regarding the issue of finding out what other ingredients are in pesticide formulas. See article about court ruling in NCAP v. EPA at http://www.pesticide.org/inertsApr03.html, and the court order at http://www.pesticide.org/inertopinion.pdf.	As stated in Section 4.6.12 of the EIS, the ingredients in a pesticide formulation other than the active ingredient are officially referred to as "other ingredients." The term "inert ingredients" is included as a parenthetical reference only for ease in locating this information for readers who may be more familiar with the historically used terminology. Federal law (FIFRA) has officially described these other ingredients using the term "inert ingredients" since 1947. However, EPA issued a policy statement in 1997 encouraging the voluntary use of the term "other ingredients", so as not to imply that these ingredients were non-toxic. See http://www.epa.gov/opprd001/inerts/ As part of the risk assessment process for this EIS, each pesticide manufacturer was contacted, and voluntarily disclosed whether any other ingredients in the proposed pesticide formulations appeared on EPA's List 1 or 2 (see Appendix C, page C-1 for more information on these lists). Four chemicals on List 2 were identified in one or more formulated products, and these were analyzed in the risk assessment along with the risks from the active ingredients. BLM believes that this approach maintained the appropriate balance between identifying and evaluating potential risks, and respecting legally protected confidential business information. It is important to note that EPA also reviews all components of every formulated pesticide product registered in the U.S., including confidential "other ingredients" that are not disclosed on the product label or the material safety data sheet.
M4-8	The chemical fertilizers that BLM uses in the seed orchard actually cause imbalances and contribute to poor health of the trees. Poor health which in turn actually invites disease, weeds, and other pests. Then pesticides are perceived to be needed to correct this, which in turn further imbalances soil fertility. Maintaining soil fertility naturally by refraining from chemicals would break this vicious cycle.	The basis of this statement is unclear. BLM is not aware of any scientific data that support a direct linkage between the fertilizers used by BLM and poor tree health. In addition, no scientific data were identified by the commentor that support her assertions. Please also refer to the response to comment M2-6 above.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M4-9	Both the active ingredients and the other ingredients (mislabeled "inerts") have lethal and sublethal effects on salmon and also impact essential fish habitat. See Diminishing Returns: Salmon Decline and Pesticides by Dr. Richard D. Ewing, PhD, February 1999. The text may also be found at http://www.pesticide.org/salpest.pdf Several pesticides and the chemical fertilizers can have devastating impacts on salmon. In the case of Washington Toxics, et al v. EPA there are rulings now calling for buffers along salmon streams when either ground or aerial spraying of these pesticide. See the Fact Sheet about Pesticides, Salmon, and Endangered Species Act herein Appendix G; the News Press Release from Earthjustice July 17, 2003 as Attachment H – the court order signed on July 16, 2003 as Attachment I; and the court order signed August 8, 2003 as Attachment J. The Fact sheet may also be found at: http://www.earthjustice.org/news/documents/7-03/salmon_lawsuit_factsheet.pdf The News Press Release may be found at: http://www.earthjustice.org/news/print.html?ID=635 The July 17th Order may be found at: http://www.pesticide.org/Order7-16-03.pdf The August 8th Order may be found at: http://agr.wa.gov/PestFert/EnvResources/docs/OrderFurtherInjunctiveRelief8-8-03.pdf The Draft EIS does not adequately address the impacts to salmon. Although the BLM chooses not to consider the salmon as an irretrievable resource, once lost, we will never get them back. By choosing chemical management, the BLM is sacrificing an endangered species for sake of saving money for private cooperators.	See reply to comment M4-7 regarding the use of the term "inerts". Section 4.7, Appendix C, and Appendix D of both the Draft and Final EISs contain analyses of the potential lethal and sublethal impacts to salmon. Because no effects are predicted, salmon are not addressed under the subject of "irretrievable commitment of resources." During the EIS process, BLM consulted with NOAA Fisheries under Section 7 of the Endangered Species Act regarding potential impacts from the proposed action to coho salmon, which are listed as "treateneed" under the Act. BLM's Biological Assessment and NOAA's Biological Opinion include analysis of the potential for both lethal and sublethal effects, as well as evaluation of the impacts to essential fish habitat. The EIS analysis did not predict any lethal or sublethal impacts to salmon from non-accident use of the proposed pesticides. See also response provided to comment M4-12.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M4-10	As far as I can find out, there was never a NEPA process whereby the public was invited to comment on the impacts of giving use of public property (the orchards of BLM) without compensation for establishment of the orchards (paid for by public funds) to private timber and seed companies to profit by the original expenditure of Federal Funding to establish the public seed orchard for the growing of trees to replant the public lands which were harvested. The BLM does not need to replant large acreages as it once did. Private timber companies can afford to pay more for the seeds for trees to replant the large acreages that it has harvested at great private gain on private lands.	The current mission of the Provolt and Sprague Seed Orchards is outside the scope of this EIS, which is limited to options for pest management at the two seed orchards. As stated in Section 1.4.1 of the Draft EIS, the Medford District Resource Management Plan/EIS included the seed orchards within the District Designated Reserve system. Please refer to Section 1.4.1 of the EIS for additional information on the provisions of the district RMP/EIS as they are applicable to Provolt and Sprague.
M4-11	Now the BLM is spending huge sums of money to develop EISs to justify using chemicals on public land rather than funding research into the alternatives to chemical management. With all the health concerns, the environmental concerns and the new endangered species concerns, these funds spent on justifying chemical use instead of research into the alternatives is a waste of public funds.	NEPA compliance is required for major Federal actions that may have an impact on the environment. BLM made a determination that an EIS was the appropriate level of NEPA documentation for the proposed IPM program. The IPM approach for any specific pest problem incorporates the best-suited method that has minimum impact on the environment and on people, as described in Section 2.2.1, and includes both chemical and non-chemical methods of pest control. BLM's immediate pest control needs are described in Chapter 1 of this EIS, and must be met using the methods available at any given time. However, Section 2.4 describes in detail a process for approving new products and technologies for inclusion in the IPM program, in keeping with the IPM principle that an effective and affordable control method with the least impact would be the manager's first choice. BLM looks forward to opportunities to expand the non-chemical pest control methods utilized by following this process, which includes mechanisms for keeping informed of new developments in seed orchard pest management, and assessing effectiveness by activities including field trials of promising technologies.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
M4-12	Damage from contamination of water, air and soil is unjustifiable. Destruction of non-target organisms is unnecessary and inconsistent with goals to maintain ecosystem balance or biodiversity. There is no need or justification for destroying salmon habitat, or for killing salmon to produce seed cheaply. The BLM has spent millions on protection and restoration of salmon habitat in other programs that it conducts (such as the fish ladder on Lake Creek at the Hult Reservoir, and at Triangle Lake), which is defeated by killing salmon and destroying salmon habitat at the Tyrrell, Provolt, Sprague and/or Horning Seed Orchards.	As summarized in Section 2.6 and Table 2.6-1, no significant impacts to air, water, or soil are predicted from implementation of Alternative B. Except for localized temporary impacts to non-target insects, or the unlikely event of an accidental spill, no risks were predicted to non-target organisms from any of the proposed pesticides. The EIS analysis did not predict the death of salmon or destruction of their habitat, nor even any sublethal effects to salmon, from non-accident use of the proposed pesticides. Please see the conclusions presented in Section 4.7 and summarized in Section 2.6 and Table 2.6-1. It should also be noted that the purpose and need for this action is to manage pests at the seed orchards, and not to maintain ecosystem balance or biodiversity, as may have been implied by this comment. While these are important considerations, and are factors in identifying potential impacts of the proposed action, they are not stated as "goals" for the purpose of this NEPA process.

Table E-2. Comments and Responses (continued)

Comment Number	Comment	Response
Mr. Brian A. Schlaefil, Area Chief Forester, Boise Building Solutions, Western Oregon Timberlands, Medford, Oregon		
M5-1	Forests on a local, national, and global basis are expected to fulfill many roles and to produce many benefits. Roles span the entire spectrum from reserve forest to production forests and the benefits might be social, economic, environmental (e.g. production of clean air and water), and/or spiritual. On the Medford BLM District these roles and benefits are expected across your land base at some time or at some location. As more forest acres are placed in reserve forests where little or no harvest will occur, then the remaining acres where some level of harvest is allowed must be even more productive to meet the needs and desires of society for wood products. Even in reserve forests, recent large wildfires have burned at catastrophic intensity on many acres within Late Successional Reserves (LSRs). Many acres where the goal is to have large, green trees must now start over with seedlings. It will be many years before these acres have large, green trees on them again.. Clearly, one useful tool to produce highly productive forests or to grow big trees faster from seedlings is the use of improved seed from the Provolt seed orchard and the rust resistant seed from the Sprague seed orchard. Every permitted tool should be retained and appropriately implemented to produce a consistent and sustainable quantity and quality of sufficient seed from these orchards for the use in the Medford BLM's reforestation efforts. *--and--* Prompt reforestation after harvest or after wildfire with improved seed from Provolt and rust-resistant seed from Sprague will help ensure productive forests for the future and help to re-establish big trees in reserve forests ravaged by recent (and future) stand replacement fires. If you retain every permitted tool, including chemical pesticides, then you will be better able to meet current and future seed needs for reforestation on the Medford BLM. You will also help in fulfilling many roles of the forest and in providing current and future benefits from the Medford BLM's forest.	Support for the availability of a full range of pest management methods is noted.
M5-2	I support the selection of Alternative B in the DEIS as the preferred action. However, careful selection and application of pesticides, following the product label, and adhering to the Environmental Protection Agency's Worker Protection Standard will provide adequate protection to human health and to the environment. Please do not be too quick to disqualify these tools from your integrated pest management program as you manage these two seed orchards.	Support for Alternative B (BLM's proposed action and preferred alternative) is noted.

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

CERTIFIED ORIGINAL

ENVIRONMENTAL IMPACT STATEMENT:

INTEGRATED PEST MANAGEMENT PROGRAM AT

PROVOLT SEED ORCHARD

PUBLIC MEETING

TUESDAY, JULY 15, 2003

BLM MEDFORD DISTRICT

REPORTED BY:
MELANIE J. SAVORD
Certified Shorthand Reporter
Certificate No. 96-0325

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where you can find it to help clarify something.

Under the provisions of the Privacy Act, you may request that your address not be printed in the final EIS. And that document will present all the comments received.

So, at this time I will ask that one by one, using the comment cards, step up to the front with your comments. Don't rush up to the front at one time. Dale is excluded.

MR. NUNNALLY: My name is Gordon Nunnally. Actually, I'm a volunteer here. I'm retired from pest control in California so this is not necessarily a new one. I'm glad to see that you are moving towards this Alternative B. Hopefully you will get the okay to follow it up. I understand that some years they use as much as 50 percent of the production for pests in operations for profit. That would not be acceptable. And it's my understanding with wine grapes -- they are not concerned about cosmetics because the consumer doesn't see the wine grape. The consumer is not going to see the seed. It might be damaged. So, less concerned with cosmetics. So, there will be less pressure to control a cosmetic injury.

M1-1

But I do think IPM is the way to go. It postpones resistance which, unfortunately, seems to happen with many pesticides. I see that unfortunately -- my mind is really no different between antibiotics and pesticides;

M1-1

they are all being used to control a pest. And there's pests here in this orchard. And I'm supportive. I have skimmed this; I haven't read it, but I have skimmed it. Looks like Alternative B is the way to go in my opinion. Thanks for your time.

M1-1

MR. KOESTER: Thank you. Anyone else? Remember your comments and concerns are an integral part of this NEPA process. Thanks for coming today. Your comments will be taken seriously and addressed in the final EIS. Remember to submit your comments by August 25th. And feel free, if you haven't already done so, to look around at the maps and the exhibits and to ask us to point out points in the document if you wish. But if we don't have any more comments -- thank you very much.

(Hearing concluded at 2:58 p.m.)

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

Received
AUG 2003
District Office
Medford, BLM

Refer to:
OHB2003-0192-GC

August 13, 2003

Mr. Harvey Koester, Manager
Provolt and Sprague Seed Orchards
3040 Biddle Road
Medford, OR 97504

Re: Draft Environmental Impact Statement for the Proposed Integrated Pest Management (IPM) Program at the Bureau of Land Management's (BLM) Provolt and Sprague Seed Orchards

Dear Mr. Koester:

NOAA's National Marine Fisheries Service (NOAA Fisheries) staff have reviewed the above mentioned draft Environmental Impact Statement (EIS), and present these comments[1] within the context of the National Environmental Policy Act (NEPA) and in anticipation of a section 7(a)(2) consultation under the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act (MSA). In accordance with NEPA regulations at 40 CFR part 1503.2, "federal agencies with jurisdiction by law or special expertise with respect to any environmental impact involved and agencies which are authorized to develop and enforce environmental standards shall comment on statements within their jurisdiction, expertise, or authority". These comments are on the preferred alternative (Alternative B-IPM with Environmental Protection Emphasis) as described in the draft EIS.

M2-1

The use of monitoring results related to adaptive management is an important component of the preferred alternative. The draft EIS refers to the importance of integrating monitoring data with future management: "....[adaptive management] would provide a relationship between monitoring results and the management that is planned for the future." (BLM., draft EIS page b-4). NOAA Fisheries agrees that using monitoring data to adjust subsequent applications of compounds[2] is vital to a multi-year approach, and presents the following guidance as a proposed structure to achieve this.

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[1] As the proposed action is continued to be refined, additional comments will likely be delivered to the BLM within the context of ESA section 7(a)(2) and MSA consultation.

[2] "Compounds" is defined as pesticides, herbicides and fertilizers.

M2-1

The EIS should be enhanced by describing the integration of monitoring data that will inform annual application variables as described in the tables of Chapter 2 of the draft EIS. Annual reports should be paired with new proposed application schedules for the upcoming year, which can be modified if necessary by the previous years monitoring results. These yearly reports would facilitate multi-year consultation that accounts for the variability of potential monitoring results, compounds planned for use and application location, method, and timing.

In summary, the annual reports should include: (1) Monitoring results that synthesize the relative effectiveness of application methods and timing to avoid effects to aquatic species; (2) a literature review of any new studies that illuminate effects (from compounds used on the orchards) to aquatic life[3] that are not accounted for in the original EIS; (3) a review of any new best management practices that may further reduce risk to aquatic species; (4) a new annual application schedule that details the type, location, timing, amounts and methods to reduce or avoid effects from compound application, and (5) a new effects analysis, as appropriate, that assesses whether any of the above factors result in effects to aquatic species not analyzed in the EIS and biological opinion (Opinion).

If the new annual application plan is within the range of effects analyzed in the Opinion, NOAA Fisheries will indicate in writing that a new section 7(a)(2) or MSA consultation is not necessary, therefore continuing coverage of the Incidental Take Statement of the Opinion for another year. NOAA Fisheries would issue the original Opinion for five years, with annual reports informing whether subsequent Opinions or MSA consultations are necessary for each orchard. These provisions would ensure that the BLM and NOAA Fisheries utilize best available scientific and commercial data to minimize and avoid adverse effects to listed species within the action area.

Additional comments on the draft EIS, are provided below:

Monitoring

M2-2
- The monitoring section only refers to pesticides. Monitoring should be conducted for fertilizers as well.

M2-3
- The EIS should provide a definition of "high risk applications" that will be targeted for applications.

M2-4
- Monitoring frequency should be described for surface water sampling events.

M2-5
- Within validation monitoring, a definition of "significant rainfall events" should be provided.

[3] "Aquatic Life" includes species listed as threatened or endangered under the ESA and those protected under the MSA and their prey base. Species covered under the ESA can be found at: http://www.nwr.noaa.gov/esalist.htm. A list of species covered by the MSA, by geographic area and habitat type, can be found at: http://www.nwr.noaa.gov/1habcon/habweb/msa.htm.

M2-6

Fertilizer Application

Fertilizers application should occur at agronomic rates, as defined the amount of nutrients applied to vegetation equal the anticipated biological uptake of the plants. This eliminates excess nutrients from polluting surface or ground waters.

M2-7

Buffer Widths

Proposed buffer widths for each compound for the orchard unit, as appropriate, should be included in the EIS. Given the vagaries of application conditions and timing, keeping the buffer widths fixed for the term of the consultation is desired by NOAA Fisheries. At the end of the consultation term and subsequent to additional consultation, the opportunity of reduced buffer widths could be discussed. This would take advantage of a larger data set from monitoring, and generally lead to more informed decisions on buffer widths.

M2-8

Synergistic Effects

To the greatest extent possible, the potential effects to aquatic life from multiple compound use within the action area should be described.

M2-9

Prescribed Fire

NOAA Fisheries prefers that extensive prescribed fire not occur within riparian areas. In cases where the BLM prefers to utilize prescribed fire within riparian areas, the extent should be limited and management methods described that facilitate native vegetation regrowth, and prevention of exposed soils, etc. The EIS should identify these site specific provisions.

M2-10

Sublethal Effects

An assessment of sublethal effects should be included for the irrigation ditch segments within the Provolt Orchard.

M2-11

Drift and Runoff Prevention

As suggested in the draft EIS, the irrigation ditches within the Provolt Orchard offer an additional vector for compound introduction to surface waters. These irrigation ditches have grass species on each bank that offer reduced preventative function for the introduction of compounds from spills, drift[4] and overland surface water flows relative to more diverse vegetative communities. In the event of compounds reaching the irrigation ditches, return flows to salmon bearing waters could adversely effect aquatic life. While mixing and dilution will occur, the relatively stable hydraulic characteristics of the ditches may prevent significant dilution[5]. The BLM should plant vegetation (i.e. shrubs) that offer an increased measure of protection from contamination, or tight-line the irrigation ditches which would virtually eliminate

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[4] While the Provolt Orchard does not include aerial applications, drift could occur from other application methods.

[5] Hydrologically complex waterways with meanders, pools, riffles, and eddies that accelerate mixing and dilution are more likely to disperse contaminant than simplified waterways with consistent channel velocities that allow contaminants to maintain a more consolidated profile (Lee 1995; Heard et al 2001).

M2-11 runoff potential. In addition, shrubs or tight-lining would prevent return flows from heating up and transpiration loss that adversely effect listed species. An added benefit from tight-lining would be the anticipated elimination of setbacks buffers, in turn increasing pest management effectiveness.

M2-12 Enhanced buffers adjacent to Williams Creek and the Applegate River near orchard units 15, 16, and 17 (depicted in figure 2.1-1 of the draft EIS) would also reduce potential contamination through more diverse and wider vegetative communities. Given the orchards sensitivity to native conifers adjacent to production conifers, a mix of native shrubs and willows should be planted.

NOAA Fisheries appreciates the BLM's early coordination efforts for the proposed action, and looks forward to continuing discussions as this project progresses. If you have any questions regarding this letter, you may contact Dan Tonnes of my staff in the Oregon Habitat Branch at (503) 736-4743 or Dan.Tonnes@NOAA.gov

Sincerely

Michael P. Tehan
Oregon State Director
Habitat Conservation Division

cc: Bob Ruediger, BLM
Dale Johnson, BLM
Jason Sandahl, Labbat-Anderson Inc.

REFERENCES

Lee, K. K. 1995. Stream velocity and dispersion characteristics determined by dye tracer studies on selected stream reaches in the Willamette River Basin, Oregon. U.S. Geological Survey Water Resources Investigations Report 95-4078. Available at: http://oregon.usgs.gov/pubs_dir/pdf/95-4078.pdf. 48 p.

Heard, S. B. C. B. Gienapp, J. F. Lemire, and K. S. Heard. 2001. Transverse mixing of transported material in simple and complex stream reaches. Hydrobiologia 464:207-218

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

SEP 10 2003

Reply To
Attn Of: ECO-088

Ref: 01-016-BLM, 01-017-BLM,
01-018-BLM, & 01-019-BLM

Mr. Harvey Koester, Manager
Bureau of Land Management
Provolt and Sprague Seed Orchards
3040 Biddle Road
Medford, OR 97504

Mr. Glenn Miller, Manager
Bureau of Land Management
Tyrrell Seed Orchard
P.O. Box 121
Lorane, OR 97451

Mr. Greg Tyler, Manager
Bureau of Land Management
Horning Seed Orchard
27004 Scheckly Road
Colton, OR 97017

Dear BLM Seed Orchard Managers:

The U.S. Environmental Protection Agency (EPA) has reviewed three Draft Environmental Impact Statements (DEIS) for the proposed **Integrated Pest Management Programs, Provolt Seed Orchard and Sprague Seed Orchard, Walter H. Horning Seed Orchard, and Travis Tyrrell Seed Orchard** pursuant to our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA) as amended. Section 309, independent of NEPA, directs U.S. EPA to review and comment in writing on the environmental impacts associated with all major federal actions.

The Bureau of Land Management (BLM) is proposing to implement a common integrated pest management (IPM) program at four seed orchard operations in the Oregonian towns of Provolt, (Provolt Seed Orchard), Merlin (Sprague Seed Orchard), Colton (Walter H. Horning Seed Orchard), and Loraine (Travis Seed Orchard). All four DEISs propose the same four Action Alternatives:

- Maximum Production IPM (Alternative A)
- IPM with Environmental Protection Emphasis (Alternative B),
- Ground-Based IPM (Alternative C)
- Non-Chemical Pest Management (Alternative D)

For baseline purposes, all of the DEISs have proposed the No Action Alternative (Alternative E) which is the current management approach. Also, all of the DEISs have identified Alternative B as BLM's Proposed Alternative.

M3-1 U.S. EPA supports the direction and intent of BLM's Preferred Alternative because it emphasizes environmental protection int the management of pests and seed orchards.

M3-2 Based on our review, we have rated the DEIS, EC-2 (Environmental Concerns - Insufficient Information). The rating and a summary of our comments will be published in the *Federal Register*. Our detailed comments and a summary of the rating system we used in our evaluation of this DEIS are enclosed for your reference.

M3-3 We recommend that the FEIS discuss additional pesticide safety issues, consider additional IPM methodologies for potentially new orchard diseases, and address the relevancy of a concurrent BLM Draft Supplemental Environmental Impact Statement (Management of Port-Orford-Cedar by Southwest Oregon) which BLM is working on that may impact proposed activities for the four seeds orchards. We also recommend that the FEIS discuss how a recent Western District Court decision may affect the Action Alternatives, especially the Preferred Alternative.

I encourage you to contact Tom Connor at (206) 553-4423 or Sharon Collman, our Pesticides/IPM Outreach Coordinator, at (206) 553-2876 if you would like to discuss our comments. Thank you for the opportunity to review these four Draft EISs on the Integrated Pest Management Program for BLM's Provolt, Sprague, Horning, and Tyrrell Seed Orchards.

Sincerely,

Judith Leckrone Lee, Manager
Geographic Unit

Enclosures

U.S. ENVIRONMENTAL PROTECTION AGENCY'S DETAILED COMMENTS ON THE INTEGRATED PEST MANAGEMENT, PROVOLT, CHARLES A. SPRAGUE, WALTER H. HORNING, AND TRAVIS TYRRELL SEED ORCHARDS ENVIRONMENTAL IMPACT STATEMENTS

Environmental Issues

List of Proposed Pesticides

M3-4 **M3-5** **M3-6**

U.S. EPA recommends that the list of proposed pesticides for use in the seed orchards be wisely considered for potential impacts to worker safety and non-target species. Many of the proposed insecticides identified in the DEIS are older, non-specific pesticides which must be treated with care to minimize damaging non-target organisms and worker safety. Some (e.g. picloram or triclopyr) are known to be highly soluble and under some conditions (rainfall, soil type, amount used) could contaminate groundwater. Some may be reasonably safe to humans but highly toxic to wildlife. For example, diazinon is highly toxic to some birds, and there is recent research suggesting that they impair salmonid olfaction functions at very low levels.

M3-7

We recommend that BLM access and run the Natural Recource Conservation Service model, WIN-PEST, for its fields and the planned pesticides as a preliminary analysis of environmental and human risk potential. This modeling program is available to anyone via the web at the NRCS website www.wcc.nrcs.usda.gov/pestmgt/winpst.html.

The program needs to have the user input their field soil type(s) (the entire US database is available within this program, the user only needs to know the map unit code or soil series from a soil survey map of their area) and then select the pesticides that will be used on that field. There are a few additional variables to provide including probability of rain following application, pesticide rate (low, med, standard), soil verses foliar applied, broadcast verses banded application as well as others. The model will run a soil type by pesticide interaction and produce a series of human health and aquatic hazard quotients (Extra High risk to Very Low and categories in between) based on the ability of the soilxpesticide to leach to groundwater or runoff via sediment or soil solution.

There are many NRCS field offices with staff trained on this program. Also, Oregon State University just received a grant to train technical service providers on using the tool (Paul Jepson and Dan Sullivan at OSU).

Root Rot *(Phytophthora)* on Port-Orford-Cedar

M3-8

We recommend that the FEIS explore the potential of using antagonistic fungi, a constituent of finished compost called a fungistat, as a tool for managing and preventing Phytophthora within seed orchard operations. A fungistat is a compound that inhibits fungal growth or sporulation but does not cause death. A fungistat keeps the disease from progressing once it is in the tree but does not necessarily cure the tree, hence repeated applications are necessary. Research in California has shown some composts enhance biological activity of antagonistic fungi that attack *Verticillium* and *Phytophthora*. Since we did not see a reference in the DEIS to fungistats, we suggest that the FEIS investigate and disclose the potential of using fungistats as a means to mitigate any outbreak of *Phytophthora* infections within a seed orchard's stock of Port-Orford-Cedars.

Sudden Oak Death (*Phytophthora ramorum*)

M3-9

Sudden Oak Death (SOD) is damaging pathogenic fungus-like algae that invades the bark killing the entire tree or portions of the tree. SOD is spreading across west coast states and its known host species is also expanding. This pathogen, first detected in California in 1995, has advanced northward into southwestern Oregon. According to announcements in early 2001 from Oregon Department of Agriculture and Forestry, the U.S. Forest Service, and BLM, SOD had invaded southwestern Oregon. In addition, SOD can infect many different genuses and species. In 2002, University of California researchers confirmed that coastal redwoods (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii* var. menziesii) are host species for the SOD pathogen. The confirmed host species list includes 20 broadleaf species involving 12 different families. A tentative host list is even considerably longer. The potential impact of this pathogen on the seed orchards' tree stocks should not be overlooked. On most non-oak hosts, SOD primarily attacks foliage or stems resulting in non-lethal damage to plants, and it could impact seed production. On Douglas firs for example, the pathogenic infestation causes cankers on small branches, wilting of new shoots, and some dieback of branches and needles (University of California). Furthermore, with the understanding that oak stands are known to exist outside some of the seed orchard areas, the FEISs should address the potential transfer of this pathogen from outside sources into the seed orchards

Phytophthora ramorum and lateralis

M3-10

The FEIS should disclose how BLM will address the potential for spread of the pathogens *P. ramorum and P. lateralis* through the movement of seedlings, or by infested plant parts such as firewood, wood chips, mulch, leaves, or soil. Oregon Department of Agriculture has reported that researchers have found that *P. ramorum* moves with wood, leaves, surface waters (i.e., streams) and soil. The role of insects and birds in spread of *P. ramorum* disease is also under investigation. The California Department of Agriculture quarantine regulates the movement of bark, bark chips, and mulch. Since the DEIS proposes to dispose of wood from trees by selling it as firewood, be advised that firewood is another potential source of the spread of *P. spp.*, particularly *P. lateralis*. In addition, tractors, to a lesser extent, have considerable

M3-10

potential for moving the spores within soil from one area to another. These pathogens can also be spread through a watershed via streams from spores in water since the spores can readily adhere to eroded soil particles. Finally, we are aware that some organizations have established protection zones along hilltops to prevent the spread of *P. lateralis* downstream in the watershed.

Potential Improvements to the Proposed IPM Program

M3-11

(1) Parasitoids. We suggest that the FEIS consider using parasitoids as another viable biological control methodology of unwanted orchard pests. Insect parasitoids have an immature life stage that develops on or within an insect host, ultimately killing the host species (Biological Control: A Guide to Natural Enemies, Cornell University). Parasitoids can be the dominant and most effective natural enemy of some pest insects, but their presence may not be obvious because parasitoid adults are small and often overlooked. The parasitoid larva inside a cone or seed may look similar to other pest species and could be incorrectly identified as a pest.

Under traditional cultural methods, a seed orchard often will have limited sources of available pollen (for egg production) and nectar (for food energy). In these circumstances, parasitoid activity may be naturally low, but could be enhanced with the addition of plants that would provide low-growing flowers for easy parasitoid access. It may be possible to find suitable flowers that would provide nectar and pollen sources without creating additional problems such as increasing fire danger. It may also be possible to monitor parasitoid activity when a subsample of cones are dissected and checked for the presence of seed infesting insects prior to harvest.

M3-12

(2) Pheromone Traps. We suggest that the FEIS explore the practice of attract-and-kill technology as exemplified by pheromone traps within seed orchards. Pheromone traps utilize chemical attractants which can be used to monitor the presence of certain pest species. While we understand that numbers of individuals captured are not directly related to damage levels in a field, traps can be monitoring tools to detect the presence of specific pests thereby alerting the manager so that appropriate action(s) can be more precisely timed. While the technology is still incomplete, there is some value in using pheromone traps as additional tools in the proposed IPM program.

Pesticide Restrictions

M3-13

Regarding the 54 Pesticides Cited in Washington Toxics Coalition, et al. vs U.S. EPA

BLM should be aware of recent a Western District Court decision (Washington Toxics Coalition, et al. vs U.S. EPA; Western Dist. of Washington at Seattle, Civ. No. C01-132C) which may result in use restrictions of 54 pesticides on federally-listed endangered and threatened salmonids. The court case identified 54 different pesticides (herbicides, insecticides, and fungicides) of concern. The FEIS should evaluate how this Court decision may affect the Preferred Alternative, including pesticide use near salmonid-bearing waters within the project areas.

Additional Concern

M3-14

Agency Management and Preservation of Port-Orford-Cedar

We recommend that the FEIS disclose how BLM will manage and preserve the Port-Orford-Cedar both at the seed orchard scale and across the landscape within which this unique species lives. BLM is involved in two separate yet connected NEPA processes: these three EISs and another concurrent NEPA process for the management of Port-Orford-Cedar in southwestern Oregon (*Draft Supplemental Environmental Impact Statement, Management of Port-Orford-Cedar in Southwest Oregon*).

Port-Orford-Cedar is an important tree species of south western Oregon and northern California both for its lumber quality and its functions within regional forest dynamics and processes. Unfortunately, the root rot disease (*Phytophthora*) referenced above has caused and is continuing to cause concern for the management and preservation of this tree species. For continuity of agency management and preservation activities, we strongly recommend that the FEIS for the four seed orchards should disclose their contributing part to protect this valued tree species.

M3-15

Improved Cartographic Information

We recommend that all the FEISs improve their cartographic information on illustrating the extent and location of both perennial and ephemeral waterbodies (streams, rivers, wetlands, ponds) and cartographically present the permanence or seasonality of these systems so that appropriate prescriptions and land management allocations are more easily understood by land managers, project reviewers and the general public.

We recommend a consistent format of cartographic information among the EISs on water resource information. As a suggestion, Figure 3.4-1 on page 3-7 in the IPM, Travis Tyrrell Seed Orchard DEIS provides the best presentation of the extent and location of perennial and ephemeral streams in the project area. Also, Figure 3.4-1, in the IPM, Water H. Horning Seed Orchard, provides adequate presentation of the extent and location of wetlands within the project area.

U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements Definitions and Follow-Up Action*

Environmental Impact of the Action

LO – Lack of Objections

The U.S. Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC – Environmental Concerns

EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO – Environmental Objections

EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU – Environmentally Unsatisfactory

EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 – Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 – Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 – Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

08/25/2003 PAGE 01/01

FAX – Comments Provolt/Sprague

Date August 25, 2003

Number of pages including cover sheet =

To: Harvey Koester, Manager
Medford BLM
Provolt and Sprague
Seed Orchard , 3040 Biddle Road
Medford, OR 97504
Phone
Fax Phone (541) 618-2400

From: Jan Wroncy
Post Office Box 1101
Eugene, OR 97440
Phone
Fax Phone 541-925-4130

email: Medford_SPOEIS_Mial@or.blm.gov

REMARKS: Comments on Draft Environmental Impact Statement - Integrated Pest Management for the Provolt and Sprague Seed Orchards

I need to send these comments a bit later than closing today because the electric company has been trimming and cutting trees in front of our house since 7:30 AM. The noise and the diesel fumes, as well as the potential for power outage if any limbs falling might shut off power have conspired to keep me away from my computer until 2 PM. Blachly Electric could not reschedule this activity, and since the trimming of limbs that were growing into the powerlines and burning the tips was critical, I did not want to hold up this important operation. I have attempted to finalize the comments on time, but I fear that they will not be ready for several hours. I therefore am asking you to accept these even though they might arrive after hours.

Respectfully submitted by,

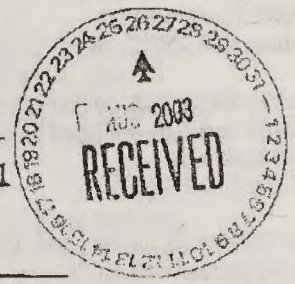
Jan Wroncy

PAGE 01

FAX – Comments Provolt/Sprague

Date August 25, 2003

Number of pages including cover sheet = 7



To: Harvey Koester, Manager	From: Jan Wroncy
Medford BLM	Post Office Box 1101
Provolt and Sprague	Eugene, OR 97440
Seed Orchard , 3040 Biddle Road	
Medford, OR 97504	
Phone	*Phone*
Fax Phone (541) 618-2400	*Fax Phone 541-925-4130*

email: Medford_SPOEIS_Mial@or.blm.gov

REMARKS: Comments on Draft Environmental Impact Statement - Integrated Pest Management for the Provolt and Sprague Seed Orchards

As I indicated yesterday, I was sickened by diesel fumes. I was ill all afternoon, evening and through this morning. I had to put in the links for the various attachments, and could not finish that yesterday because I was too sick. I just finished the printing of these comments to send to you. Please accept them for the EIS.

Respectfully submitted by,

Jan Wroncy

Glenn Miller, Manager
Travis Tyrrell Seed Orchard
Post Office Box 121
Lorane, Oregon 97451

August 25, 2003

Greg Tyler, Manager
Horning Seed Orchard
27004 Sheckly Road
Colton, OR 97017

Harvey Koester, Manager
Provolt and Sprague Seed Orchards
3040 Biddle Road
Medford, OR 97504

RE: Comments on the Draft Environmental Impact Statements for Integrated Pest Management for the Bureau of Land Management's Tyrrell, Provolt, Sprague, and Horning Seed Orchards, June 2003.

Dear Mr. Miller, Mr. Tyler and Mr. Koester:

M4-1 **On my own behalf and on behalf of the Coast Range Guardians, and Canaries Who Sing, I urge you to adopt Alternative D – Non-Chemical Pest Management for the Tyrrell Seed Orchard; Alternative D – Non-Chemical Pest Management for the Horning Seed Orchard; and Alternative C – Non-Chemical Pest Management for the Provolt and Sprague Seed Orchards.**

The Non-Chemical Pest Management "would allow the seed orchard manager to use only the biological, prescribed fire, cultural, and other non-chemical-pesticide methods listed under Alternative A. No chemical pesticides would be permitted" at page 2-17, section 2.3.4 in the Tyrrell Draft EIS; page 2-19, section 2.3.5 in the Horning Draft EIS; and at page 2-21, section 2.3.4 in the Provolt and Sprague Draft EIS.

M4-2 **However the Non-Chemical Pest Management should also include in the prohibited list, the biological control method of using a bioinsecticides, such as Bacillus *thuringiensis* - also known as Bt (formulated as Dipel, Foray 48B, Deliver). Bt formulas are PESTICIDES and do contain CHEMICALS (other ingredients, not necessarily biologically or chemically inert). Dipel, Foray 48B, and Deliver are regulated by the Federal Pesticide law and as such should be included in the Non-Chemical Pest Management prohibited list.**

M4-3 **Additionally Bacillus thuringiensis itself has been shown to have human health impacts as well as environmental impacts.**

APPEAL DECISION STILL PENDING FROM THE INTERIOR BOARD OF LAND APPEALS

I appealed the decision to aerially spray Esfenvalerate (ASANA) by the BLM at the Tyrrell Seed Orchard but have not received notification of a decision from the Interior Board of Land Appeals (IBLA) yet. The decision by the IBLA may impact the final Environmental Impact Statements for the Tyrrell, Provolt, Spague, and Horning Seed Orchards.

M4-4 I have attached the comments, protest, and some of the appeal documents I submitted on the Tyrrell Seed Orchard aerial spraying of Esfenvalerate (ASANA) in April of 2003. See **Attachment A - Comments; Attachment B - Protest; Attachment C - Appeal Statement of Reasons; Attachment D - Objections to Mootness; Attachment E - Answer to BLM's Motion to Dismiss.**

M4-5 The issues of compliance with the National Environmental Policy Act (NEPA), the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Clean Water Act (CWA), the Endangered Species Act (ESA) and other applicable laws apply also to the present Draft Environmental Impact Statements for the Tyrrell, Provolt, Sprague and Horning Seed Orchards.

BLM IS IGNORING IMPACTS OF BACILLUS *THURINGIENSIS* PESTICIDE FORMULAS

M4-2 The Bureau of Land Management is ignoring the fact that Deliver, Dipel, Foray 48B (all trade names of pesticide formulas) formulations of Bacillus thuringiensis (Bt) are in fact PESTICIDES, and are, as such, regulated by the Environmental Protection Agency (EPA) as pesticides under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and under State Pesticide Laws. Also formulas of Bt also contain chemicals serving various purposes in the formula. Thus Bt pesticides are both biological pesticides and chemical pesticides. Therefore Bt and other biopesticides should be included in the list of prohibited substances under the Non-Chemical Alternative. Additionally Bt and other biological agents do have both human health concerns and environmental impacts which must be thoroughly analyzed, and fully revealed.

M4-3 See appeal of Forest Service aerially spraying of Bacillus Thuringiensis in the Alsea Watershed this Spring, attached herein as **Attachment F.**

IMPACTS OF PESTICIDES UNDERESTIMATED

M4-6 The listed chemicals proposed for use have far more serious health and environmental effects than indicated by the Risk Assessments. Included in these comments are the following articles available from the Northwest Coalition for Alternatives to Pesticides (NCAP) located at NCAP'S website:
http://www.pesticide.org

Acephate

*Bt:
http://www.pesticide.org/bacillus.pdf

*chlorothalonil:
http://www.pesticide.org/chlorothalonil.pdf

*chlorpyrifos:
http://www.pesticide.org/chlorpyrifos1.pdf
http://www.pesticide.org/chlorpyrifos2.pdf
http://www.pesticide.org/chlorpyrifos3.pdf
http://www.pesticide.org/chlorpyrifosNEWS.pdf

*Chromated Copper Arsenate:
http://www.pesticide.org/chromated.pdf
dazomet

(formaldehyde, MITC, Monomethylamine, carbon disulfide)

*diazinon:
http://www.pesticide.org/DiazinonTox.pdf
http://www.pesticide.org/DiazinonEco.pdf
http://www.pesticide.org/diazinonNEWS.pdf

M4-6

*dicamba:
http://www.pesticide.org/dicamba.pdf

dimthoate

*esfenvalterate:
http://www.pesticide.org/toxicology.pdf

*glyphosate:
http://www.pesticide.org/gly.pdf

hexazinone

horticultural oil

*permethrin:
http://www.pesticide.org/Permethrin.pdf
http://www.pesticide.org/toxicology.pdf

M4-6

*picloram:
http://www.pesticide.org/picloram.pdf

(hexachlorobenzene)

propargite
propiconazole

*triclopyr:
http://www.pesticide.org/triclopyr.pdf

**nitrate (note that nitrate is misleading, the chemical fertilizers that BLM uses are not pure nitrate)

***Inert ingredients:
(cyclohexanone, ethylbenene, light aromatic solvent naptha, xylene)

"INERTS" NOT INERT

M4-7

***Note that "inert" ingredients are NOT INERT. See articles on "inerts" at:
http://www.pesticide.org/inertsreport.pdf
http://www.pesticide.org/ActiveInertsRpt.pdf

Additionally there has been favorable rulings regarding the issue of finding out what other ingredients are in pesticide formulas. See article about court ruling in NCAP v. EPA at:
http://www.pesticide.org/InertsApr03.html
and the court order at:
http://www.pesticide.org/inertopinion.pdf

CHEMICAL FERTILIZERS CAUSE IMBALANCES AND POOR HEALTH OF TREES

M4-8

The chemical fertilizers that BLM uses in the seed orchard actually cause soil fertility imbalances and contribute to poor health of the trees. Poor health which in turn actually invites disease, weeds and other pests. Then pesticides are perceived to be needed to correct this, which in turn further imbalances soil fertility. Maintaining soil fertility naturally by refraining from chemicals would break this vicious cycle.

IMPACTS ON SALMON

M4-9

Both the active ingredients and the other ingredients (mislabeled "inerts") have lethal and sublethal effects on salmon and also impact essential fish habitat. See Diminishing Returns Returns: Salmon Decline and Pesticides by Dr. Richard D. Ewing, PhD, February 1999.

The text also may be found at:
http://www.pesticide.org/salpest.pdf

M4-9

Several pesticides and the chemical fertilizers can have devastating impacts on salmon. In the case of Washington Toxics, et al v. EPA there are rulings now calling for buffers along salmon streams when either ground or aerial spraying of these pesticide. **See the Fact Sheet about Pesticides, Salmon, and Endangered Species Act herein Attachment G ; the News Press Release from Earthjustice July 17, 2003 as Attachment H - the court order signed on July 16, 2003 as Attachment I; and the court order signed August 8, 2003 as Attachment J.**

The Fact Sheet may also be found at:
http://www.earthjustice.org/news/documents/7-03/salmon_lawsuit_factsheet.pdf

The News Press Release may be found at:
http://www.earthjustice.org/news/print.html?ID=635

The July 17th Order may be found at:
http://www.pesticide.org/Order7-16-03.pdf

The August 8th Order may be found at:
http://agr.wa.gov/PestFert/EnvResources/docs/OrderFurtherInjunctiveRelief8-8-03.pdf

The Draft EIS does not adequately address the impacts to salmon. Although the BLM chooses not to consider the salmon an irretrievable resource, once lost, we will never get them back. By choosing chemical management, the BLM is sacrificing an endangered species for sake of saving money for private cooperators.

BLM PUBLIC FUNDING OF SEED ORCHARDS NOW BENEFITING PRIVATE TIMBER AND SEED COMPANIES AT PUBLIC EXPENSE

M4-10

As far as I can find out, there was never a NEPA process whereby the public was invited to comment on the impacts of giving use of public property (the orchards of BLM) without compensation for establishment of the orchards (paid for by public funds) to private timber and seed companies to profit by the original expenditure of Federal Funding to establish the public seed orchard for the growing of trees to replant the public lands which were harvested. The BLM does not need to replant large acreages as it once did. Private timber companies can afford to pay more for the seeds for trees to replant the large acreages that it has harvested at great private gain on private lands.

M4-11

Now the BLM is spending huge sums of money to develop EIS's to justify using chemicals on public land rather than funding research into the alternatives to chemical management. With all the health concerns, the environmental concerns and the new endangered species concerns, these funds spent on justifying chemical use instead of research into the alternatives is a waste of public funds.

M4-12

Damage from contamination of water, air and soil is unjustifiable. Destruction of non-target organisms is unnecessary and inconsistent with goals to maintain ecosystem balance or biodiversity.

There is no need or justification for destroying salmon habitat, or for killing salmon to produce seed cheaply. The BLM has spent millions on protection and restoration of salmon habitat in other programs that it conducts (such as the fish ladder on Lake Creek at the Hult Reservoir, and at Triangle Lake), which is defeated by killing salmon and destroying salmon habitat at the Tyrrell, Provolt, Spague and/or Horning Seed Orchards.

CONCLUSION

M4-1

M4-2

Therefore, the BLM should adopt the Non-Chemical Pest Management Alternative, and add to the list of prohibited substances, the biopesticides such as Bacillus *thuringiensis* pesticide formulas.

Respectfully submitted by,

Jan Wroncy

Jan Wroncy, on my own behalf, and
on behalf of Coast Range Guardians, and
Canaries Who Sing
Post Office Box 1101
Eugene, OR 97440

Boise Building Solutions
Western Oregon Timberlands
P O Box 100, Medford, OR 97501
T 541-776-6687 F 541-770-6215

BOISE

August 25, 2003

Mr. Harvey Koester, Manager
Provolt and Sprague Seed Orchards
Medford District, Bureau of Land Management
3040 Biddle Road
Medford, Oregon 97504

Dear Harv,

Please accept this letter as written comments to the Draft Environmental Impact Statement (DEIS) for Integrated Pest Management Program at the Provolt and Sprague Seed Orchards.

M5-1

Forests on a local, national, and global basis are expected to fulfill many roles and to produce many benefits. Roles span the entire spectrum from reserve forests to production forests and the benefits might be social, economic, environmental (e.g. production of clean air and water), and/or spiritual. On the Medford BLM District these roles and benefits are expected across your land base at some time or at some location. As more and more acres are set aside as reserve forests where little or no harvest will occur, then the remaining acres where some level of harvest is allowed must be even more productive to meet the needs and desires of society for wood products. Even in reserve forests, recent large wildfires have burned at catastrophic intensity on many acres within Late Successional Reserves (LSRs). Many acres where the goal is to have large, green trees must now start over with seedlings. It will be many years before these acres have large, green trees on them again.

Clearly, one useful tool to produce highly productive forests or to grow big trees faster from seedlings is the use of improved seed from the Provolt seed orchard and the rust resistant seed from the Sprague seed orchard. Every permitted tool should be retained and appropriately implemented to produce a consistent and sustainable quantity and quality of sufficient seed from these orchards for the use in the Medford BLM's reforestation efforts.

M5-2

I support the selection of Alternative B in the DEIS as the preferred action. However, careful selection and application of chemical pesticides, following the product label, and adhering to the Environmental Protection Agency's Worker Protection Standard will provide adequate protection to human health and to the environment. Please do not be too quick to disqualify these tools from your integrated pest management program as you manage these two seed orchards

M5-1

M5-2

Prompt reforestation after harvest or after wildfire with improved seed from Provolt and rust resistant seed from Sprague will help ensure productive forests for the future and help to re-establish big trees in reserve forests ravaged by recent (and future) stand replacement fires. If you retain every permitted tool, including chemical pesticides, then you will be better able to meet current and future seed needs for reforestation on the Medford BLM. You will also help in fulfilling the many roles of the forest and in providing current and future benefits from the Medford BLM's forest.

Thank you for the opportunity to provide written comments.

Sincerely,

Brian A. Schlaefli
Area Chief Forester

vjm

Appendix F
NOAA Fisheries Biological Opinion Transmittal Letter and Biological Opinion

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No.:
2004/00207

February 9, 2005

Mr. Timothy B. Reuwsaat
District Manager
Medford District Office
Bureau of Land Management
3040 Biddle Road
Medford, Oregon 97504

Re: Amendment to the Endangered Species Act Interagency Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Proposed Integrated Pest Management Program at the Provolt Seed Orchard in Jackson and Josephine Counties, Oregon

Dear Mr. Reuwsaat:

On January 18, 2005, the National Marine Fisheries Service (NMFS) transmitted our biological opinion and Magnuson-Stevens Fishery Conservation and Management Act (MSA) essential fish habitat (EFH) consultation on the effects of the Bureau of Land Management's (BLM) actions to carry out the Proposed Integrated Pest Management Program at the Provolt Seed Orchard in Jackson and Josephine Counties, Oregon (Opinion) (refer to: NMFS No.: 2004/00207). That Opinion was one of four issued at approximately the same time as a result of concurrent consultations on different seed orchards in Oregon, all operated by the BLM. Since then, staff of NMFS and the BLM reviewed the results of those four consultations and found drafting errors were made such that some actions were attributed to the wrong orchard and, consequently, resulted in an improper effects analysis and incidental take statement. The enclosed document contains an amended Opinion intended to correct errors in the January 18, 2005 document, which is now withdrawn, and ensure that we have a common understanding of our consultation efforts.

In this new Opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of the Southern Oregon/Northern California coho salmon (*Oncorhynchus kisutch*), listed as threatened under the ESA. This Opinion also includes an amended incidental take statement with terms and conditions necessary to minimize the impact of the taking that is reasonably certain to be caused by this action. Take from actions by the action agency and contractors, if any, that meet these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of our amended consultation on the action's likely effects on essential fish habitats (EFH) for Chinook (*O. tshawytscha*) and coho salmon pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes three conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects to EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations. If the response is inconsistent with the recommendations, the BLM must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

I apologize for any inconvenience these errors may have caused and appreciate the interest you and your staff has in assuring that our consultations are based on the most accurate and up-to-date information available. If you have further questions, please do not hesitate to contact Dan Gambetta, fisheries biologist, at 503.231.2243, or Ken Phippen, Southwest Oregon Habitat Branch Chief, at 541.957.3385.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: Bob Ruediger, BLM
Jeannette Griese, BLM

2

Amendment to the Endangered Species Act - Section 7 Consultation Biological Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

Proposed Integrated Pest Management Program,
Provolt Seed Orchard,
Jackson and Josephine Counties, Oregon

Agency: Bureau of Land Management

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Date Issued: February 9, 2005

Issued by: F.r Michael R Crouse

D. Robert Lohn
Regional Administrator

Refer to NMFS No.: 2004/00207

Acronyms used in this document:

AgDrift - Agricultural Drift
BLM - Bureau of Land Management
BMPs - Best Management Practices
BRT - Biological Review Team
Bt - *Bacillus thuringiensis*
CFS - Cubic Feet Per Second
CPs - Conservation Practices
DOI - Department of Interior
EC - Effective Concentration
EIS - Environment Impact Statement
EFH - Essential Fish Habitat
EPA - Environmental Protection Agency
ESA - Endangered Species Act
ESUs - Evolutionarily Significant Units
EXAM - Exposure Analyis Modeling Systems
FMPs - Federal Fishery Management Plans
GLEAMS - Groundwater Loading Effects of Agricultural Management Systems
IPM - Integrated Pest Management
LC50 - Median Lethal Concentration
LOEC - Lowest Observed Effect Concentration
MSA - Magnuson-Stevens Fishery Conservation and Management Act
mg/L - milligrams per litre
MPI - Matrix of Pathways and Indicators
MOC - Method of Characteristics
NOAA Fisheries - NOAA's National Marine Fisheries Service
NWFSC - Northwest Fisheries Science Center
ODEQ - Oregon Department of Environmental Quality
ODFW - Oregon Department of Fish and Wildlife
ODF - Oregon Department of Forestry
OSUES - Oregon State University Extension Service
PFMC - Pacific Fishery Management Council
PPM - Parts Per Million
PFC - Properly Function Condition
RA - Risk Assessment
RM - River Mile
ROD - Record of Decision
SERA - Syracuse Environmental Research Associates
SONC - Southern Oregon/Northern California
SPMDs - Semi-Permeable Membrane Devices
SWW - Southwest Washington
USDA - United States Department of Agriculture
USGS - United States Geological Survey
VSP - Viable Salmonid Population
WTC - Washington Toxics Coalition

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INTRODUCTION

The Bureau of Land Management (BLM) owns and operates the 300-acre Provolt seed orchard (Provolt) near the Applegate River in Jackson and Josephine Counties in southern Oregon, to produce conifer seedlings, to preserve individual conifer trees, and to produce native plant species and seed. The purpose of the proposed action is to manage competing and unwanted vegetation, diseases, insects, and animal pests at Provolt. Proposed management consists of biological, chemical, cultural, and other methods to preserve and enhance seed orchard production. Collectively, these actions are referred to as integrated pest management (IPM).

Federal agencies are required under section 7(a)(2) of the ESA to consult with the National Marine Fisheries Service (NMFS) on their actions that authorize, fund, or carry out activities that 'may affect' ESA-listed salmonids or designated critical habitat. From a scientific perspective, among the diverse actions that 'may affect' listed fish in the Norwest Region, pesticide and herbicide applications can be the most complex. Many rivers and estuaries in the Pacific Northwest are contaminated with toxic chemicals. Water and sediment pollution can degrade fish habitat and impair the fitness of salmon and marine fish species. While there is a healthy volume of literature regarding some pesticide and herbicide effects to aquatic species, in some cases, data for a specific pesticide/herbicide on particular salmonid species and their prey, including their diverse life-stages, is lacking. To address this, a number of scientific agencies, including the Environmental Protection Agency (EPA), the NMFS' Northwest Fisheries Science Center (NWFSC), and various universities are continuing to conduct and publish studies that further describe pesticide and herbicide effects to aquatic species. Research within the NWFSC, particularly the Ecotoxicology and Environmental Fish Health Program,[1] is focused on contaminants that interfere with the normal function of the fish nervous system, and may therefore impair the survival or reproductive success of exposed fish. The NWFSC is continuing to develop new methods to detect developmental abnormalities in fish that have been exposed to common environmental chemicals.

On January 22, 2004, the U.S. District Court for the Western District of Washington ruled in the case of *Washington Toxics Coalition (WTC) v. EPA*. For ground pesticide applications, the court issued an order that establishes a 20-yard buffer zone. For aerial pesticide applications, the court order establishes a 100-yard buffer zone. These buffers are applicable beside salmon-supporting waters around certain waterbodies in California, Oregon, and Washington, to which specific pesticides cannot be applied.

Chief Judge Coughenour issued this order in response to the WTC's July 16, 2003, motion for injunctive relief to establish buffer zones as an interim measure to reduce the likelihood of jeopardy to 26 species of salmon and steelhead. This order is in effect until the EPA and NMFS have completed an evaluation of threatened and endangered Pacific salmon and steelhead and their critical habitats to exposure from 55 pesticides. Under the ESA, EPA must ensure that its

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[1] http://www.nwfsc.noaa.gov/research/divisions/ec/ecotox/index.cfm

registration of a pesticide is not likely to jeopardize the continued existence of species listed as endangered and threatened or adversely modify habitat critical to those species' survival. In addition to the obligation to ensure that its actions are not likely to jeopardize listed species, the EPA must consult, as appropriate, with the U.S. Fish and Wildlife Service (USFWS) or NMFS if a pesticide's use may affect listed species or designated critical habitat.

Background and Consultation History

This five-year consultation for Provolt was initiated by the BLM to help streamline the implementation of a comprehensive IPM program. For the past two years, the BLM and NMFS have conducted coordination meetings and correspondence to review and refine the proposed action, review versions of the draft biological assessment (BA), the Risk Assessment (RA), and the draft Environment Impact Statement (EIS). Pre-consultation coordination is summarized below. Most of the listed meetings also discussed the other seed orchards that were intended to undergo separate consultation with NMFS. The other seed orchards are Horning, Sprague, and Tyrrell, all in Oregon. The proposed IPM programs for all the seed orchards are generally similar.

- On October 29, 2002, BLM and NMFS staff toured the Provolt site.
- On July 10, 2003, NMFS and the BLM held a conference call to discuss the draft EIS and information necessary for the BA.
- On August 5, 2003, NMFS and BLM staff met to discuss structuring the BA and biological opinion (Opinion) to facilitate multi-year consultation, among other topics.
- On August 13, 2003, NMFS sent a letter to the BLM with comments on the draft EIS and in anticipation of future section 7(a)(2) consultation for Provolt.
- On November 11, 2003, NMFS sent comments through electronic mail on the draft BA.

In addition to the above, many phone calls and e-mails were exchanged between NMFS and the BLM regarding the proposed action. The BLM, at the request of NMFS, tailored their assessment of the IPM with technical guidance drafted by the NWFSC for NMFS' section 7 pesticide and herbicide consultations. The BLM provided several versions of the draft BA, risk analysis, and monitoring plans for NMFS' review and comment. In addition, the BLM reviewed a draft version of the this Opinion. Correspondence related to this consultation is available in the administrative record, at NMFS' Oregon State Habitat Office in Portland, Oregon.

NMFS received a letter dated March 2, 2003, and an accompanying BA from the BLM requesting informal consultation on the proposed five-year IPM program for the Provolt orchard. In the letter and the BA, the BLM determined that the proposed action is 'not likely to adversely affect' (NLAA) Southern Oregon/Northern California (SONC) coho salmon (*Oncorhynchus kisutch*). In March 2004, NMFS informed the BLM the proposed IPM program was 'likely to adversely affect' (LAA) SONC coho salmon, and recommended formal consultation for the proposed action.

This consultation also fulfills the essential fish habitat (EFH) consultation requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) 1996. The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)). The objective of the EFH consultation is to determine whether the proposed action will adversely affect designated EFH for Chinook and coho salmon, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

This Opinion was originally issued on January 18, 2005 and is currently being amended at the Agency's request in order to clarify the proposed action. This amendment shall supercede the previous Opinion in its entirety.

The action area for this consultation begins at the Applegate River beside and downstream from Provolt, and includes the lower portion of Williams Creek as it flows into the Applegate River. The downstream portion of the action area extends to the confluence of the Applegate River and the Rogue River below Provolt.

Description of the Proposed Actions

Management of pests enables the seed orchard to produce improved seed for conifer seedling production, to preserve valuable individual conifer trees, to produce native species plants and plant species seed, and to produce containerized seedlings in a greenhouse nursery. This seed is supplied to BLM and other cooperators for reforestation and restoration projects.

The pest management objectives at Provolt include the following:

1. Minimize insect damage to orchard trees, cone crops, and native plants.
2. Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
3. Reduce growth of vegetation to allow tree establishment and growth, and reduce the fire hazard.
4. Treat fungal and bacterial diseases to maintain the health and vigor of the orchard trees used for seed production and control plant pathogens in native seedling grow-out beds.
5. Minimize animal damage to orchard trees, orchard equipment and infrastructure.

The BA states that it is the policy of the Department of Interior (DOI) to use chemical pesticides only after considering all the alternatives, and to develop, support, and adopt IPM strategies wherever practicable (DOI 1981). The concept of IPM incorporated in the BA is as follows:

> IPM is an approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops, harming animals, infesting buildings or otherwise

interfering with our livelihood or enjoyment of life. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels. Any action taken is designed to target the troublesome pest, and limit the impact on other organisms and the environment. Applying pesticides to crops, animals, buildings or landscapes on a routine basis, regardless of need, is not IPM.

The BA further defines the context for the proposed Provolt IPM, emphasizing the holistic approach to pest management consistent with DOI policy, and the integration of a broad range of pest control methods:

> IPM for seed orchards is the maintenance of seed orchard pests at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory methods (including no action) that are consistent with orchard management goals. Each pest management activity is the end result of a decision-making process where pest problems and their impact on hosts are considered, and control methods are analyzed for their effectiveness, as well as their impacts on economics, human health, and the environment. Deciding which particular method would be used depends on several factors. Initial questions at the seed orchard might include, 'Is it really necessary to control this pest? Can we live with the damage and still have the trees survive and produce suitable amounts of seed?' If the answers are yes and no, respectively, then decisions must be made as to what method(s) of control to use.
>
> The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed (BLM 2004).

The BLM has proposed a number of specific measures to address unwanted vegetation, insects, disease, and animal pests at Provolt. These measures generally fall into the following categories:

- Biological controls, such as bird or bat boxes to attract insect-eaters, or encouraging predators that can control animal pests.
- Prescribed burning to remove vegetation.
- Cultural methods, including mechanical (tractor mowing) and manual (pruning) methods, mulch mats, and fences.
- Chemical insecticides, herbicides, fungicides and fertilizers.

Biological Controls

Biological pest control is the deliberate use of insect pests' natural enemies, such as parasites, predators, or disease organisms, to reduce pest populations. Three types of biological controls are in use, or proposed for use, to manage insect pests.

1. Bird boxes have been installed throughout Provolt to attract cavity-nesting birds into Provolt to nest and feed.
2. Bat houses have been placed throughout Provolt to provide roosting and breeding habitat to encourage bats, such as the big brown bat and little brown myotis, to live in the vicinity and feed on insects in Provolt.
3. *Bacillus thuringiensis* (Bt) is being considered to help reduce insect damage at Provolt.

Prescribed Burning

The BLM proposed annual controlled broadcast burning to control 1 to 2 acres of vegetation along fence lines, roadsides, and irrigation ditches during the winter and early spring months. Once or twice each year (in spring or early winter), one or two piles are planned to be burned by BLM fire specialists.

Pile burning of insect-infested vegetation or cones once or twice per year will reduce insect populations by eliminating habitat which would otherwise allow the pupae to emerge in spring as adult insects. Pile-burning of vegetation with disease infections is a sanitation method of control which eliminates the infected material and reduces the risk of spreading the disease within Provolt.

In addition, prescribed fire could be used for removing vegetation in native species beds before planting. High temperatures, created through the use of a propane-fueled flame wand, kills any existing herbaceous material, provides a weed-free bed for growing native plants, and removes dead plant litter. Prescribed fire may also be used to remove native grass straw after seed harvest or diseased native grasses in native species beds. Prescribed fire is not proposed for use in riparian areas.

Cultural Methods

The following methods may be used for various applications:

1. Vegetation. Hand-pulling, pruning, thinning, hand tools to cut and grub, tractors with various blade attachments for mowing, gasoline-powered string trimmers, brush cutter machine mounted on tractor, chainsaw for cutting up thinned, rogued, dead/dying orchard trees, power pruner, wood chipper, chipping with large tub grinders and marketing the chips for energy development, and mulch mats.
2. Disease. Pruning, power saws to cut infected or dead trees, removal of diseased plants from the native plant gardens using a tractor and rototiller, mesh shade screens to protect seedlings from heat damage, hand-painting older trees with exposed and thin bark to reflect the sun's rays and insulate from extreme heat.
3. Animal pests. Trapping of gophers, porcupines, and other small mammals, fencing that excludes deer and elk from the orchard, Vexar™ tubes to protect seedlings, use of sticky traps in greenhouses, screening to exclude squirrels from seed extractory and cone shed.

4. Insects. Pruning, thinning, shaping, use of grafting wax or spray seal on tree wounds, sanitation of damaged branches and trees, sanitation of insect-damaged cones and cones not harvested for seed production, hand-picking large and noticeable insect pupae.

Chemical Pesticides (insecticides, herbicides, fungicides and fertilizers)

Table 1 lists the chemical pesticides, herbicides, and fertilizers proposed for use at Provolt.

Table 1. Compounds Proposed for use at Provolt

Insecticides	Fungicides	Herbicides	Fertilizers
-acephate -chlorpyrifos -diazinon -dimethoate -esfenvalerate -horticultural oil -imidacloprid -permethrin -potassium salts of fatty acids (Safer® Soap) -propargite (miticide)	-chlorothalonil	-dicamba -glyphosate -picloram	-ammonium nitrate -ammonium sulfate -monoammonium and -diammonium phosphate -potassium nitrate

Table 2 provides the relative toxicity to salmonids and insects, and application data as proposed by the BLM.

Table 2. Pesticide, Herbicide and Fertilizer Data

Pesticide	Chemical Family	Pest. Use	Fish Acute Toxicity	Application Date Range	Application Frequency	Application Method
Acephate	Organo-phosphate	I	Slightly toxic	Mar-Apr	Every 1 to 3 Years	Implants
B.t.	Biological	I	No Data Available	Mar-Jul	Annually	HPHS or HSHHW
Chlorpyrifos	Organo-phosphate	I	Very highly toxic	May-Sep	1 to 2X in a 10 year period	HPHS or HSHHW
Diazinon	Organo-phosphate	I	Very highly toxic	Apr-Sep	1 to 2X in a 5 year period	HPHS or HSHHW
Dimethoate	Organo-phosphate	I	Slightly to moderately toxic	Apr-Sep	Only if Esfenvalerate unavailable	HSHHW or BS
Esfenvalerate	Pyrethroid	I	Very highly toxic	Apr-Jul	Annually	HPHS -or- HSHHW -or- BS
Horticultural Oil	Petro-Chem	I	Moderate to highly toxic	Mar - Sep (as additive) Sep - May (dormant oil)	Every 1 to 2 years as an alt or supplement to non-chemical treatment	HPHS
Permethrin	Pyrethroid	I	Very highly toxic	May-Jul	As back up or alternative to esfenvalerate	HPHS HSHHW or BS
Potassium Salts of Fatty Acids	Fatty Acids	I,F,H	Slightly toxic	Mar-Sep	Every 1 to 2 years as an alt or supplement to non-chemical treatment	HPHS or HSHHW or BS
Propargite	Organosulfite	I	Highly Toxic	Apr-Oct	1 to 2X in a 10-year period	HPHS or HSHHW or BS
Chlorothalonil	Chlorinated benzene nitrile	F	Very Highly Toxic	Feb-Jun	1 to 2X in a 5 year period	HPHS

Pesticide	Chemical Family	Pest. Use	Fish Acute Toxicity	Application Date Range	Application Frequency	Application Method
Dicamba	Benzoic acid derivative	H	Slightly toxic	Apr-Jun	Back up or Alt. to glyphosate or for persistent weeds	HSHHW or BS
				Mar-Jul		Tractor-pulled spray rig w/ boom
				Mar-Jul		HHW
Glyphosates (roundup)	Amino acid derivative	H	Moderately toxic	Apr -Aug	Initially 2 to 3X per year, as plant pop. diminish, then 1 to 2X per year	Tractor-pulled spray rig w/ boom
						HSHHW or BS
Glyphosate (rodeo)	Amino acid derivative	H	Moderately toxic			HHW
Picloram	Picolinic acid derivative	H	Slightly to moderately toxic	Apr-Jun	1 to 2X in a 10-year period	HSHHW -or- BS
Triclopyr	Amine salt	H	Slightly to moderately toxic	Apr-Jun	1 to 2X in a 10-year period	HSHHW or BS

Relative fish toxicity as determined by the Pesticide Action Network (PAN)[2]

KEY:
I = insecticide, F = fungicide, H = herbicide
HSHHW=Hydraulic Sprayer with Hand Held Wand, BS=Backpack Sprayer, HPHS=High Pressure Hydraulic Sprayer, HS=Hand Sprayer

Proposed Conservation Practices (CPs)

1. To decrease the potential for drift or runoff to surface water, esfenvalerate would not be applied to trees in the two rows of orchard trees nearest and directly beside Williams Creek in units beside the creek: units 1, 5, 7, 9, and 17; and the two rows of trees nearest the two irrigation ditches in units 5, 7, 12, 14, 15, and 16. These trees would then act as an additional shield against drift toward the surface water, as well as increase the buffer against overland runoff containing pesticide residues by as much as 200% in some areas.
2. Insecticides would not be applied using a high-pressure hydraulic sprayer to the two rows of trees nearest and directly beside any open water, to provide a buffer from drift or runoff.

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[2] PAN can be accessed at: http://www.pesticideinfo.org/Index.html

3. Pesticides would be applied within the parameters of prescribed environmental conditions stated on the label.
4. No spraying would occur if snow or ice covers the target foliage.
5. Temperatures shall be monitored carefully.
6. If possible, spraying would be conducted during the early morning or late evening, allowing foliage to dry before pollinators become active.
7. Orchard fields would be mowed before insecticide applications, to remove floral components on ground cover that would attract pollinators, such as bees (if pollinators are active).
8. Chemical weed control within 20 feet of perennial and non-perennial streams with flowing water at the time of application would be limited to spot hand applications. In stream reaches where foliar applications of Rodeo® are used to treat knotweed growing in dry portions of the stream channel below the ordinary high water elevation, application is limited to the dry portions of the stream channel in the preferred in-water work period, in accordance with Oregon Department of Fish and Wildlife (ODFW) guidance.
9. No carrier other than water will be used to mix (dilute) the pesticide products for application. In some cases, surfactants or adjuvants may be added to application mixtures of pesticides to improve their effectiveness or minimize handling and application problems. The seed orchard will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000a). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical will be evaluated before a use determination is made.
10. Maintenance and calibration of spray equipment will occur at least annually to ensure proper application rates.
11. No more than one application of picloram will be made on an area in any given year to reduce the potential for picloram accumulation in the soil.
12. Permethrin and Esfenvalerate will not be used in the same year.
13. Applications will be timed, to the extent predictable by weather forecasts, to not coincide or closely precede a large storm event that could result in substantial runoff.

Proposed Spill CPs

1. Equipment used for pesticide transport, mixing, and application will be properly maintained to avoid leaking pesticides into water or soil.
2. Pesticides will be mixed and equipment cleaned in areas protected (*i.e.*, paved and bermed, or on a portable, bermed mixing pad) from the potential for runoff to surface waters or leaching to groundwater in the case of a spill.

Proposed Drift CPs

1. Factors such as relative humidity, wind speed, and air temperature shall be considered to determine the timing of applications that will minimize the potential for off-target drift.

2. Drift cards would be used to indicate when spray is heading toward a riparian zone, and spraying would cease if this danger seems likely.
3. When spraying trees within two tree rows from the edge of treatment unit perimeters, spraying will be done by directing the nozzle towards the center of the treatment unit, minimizing the chance for drift outside the designated treatment areas.

Proposed Application Methods. Pesticides may be applied using several methods, including: (1) High-pressure hydraulic sprayer; (2) hydraulic sprayer with hand-held wand; (3) tractor-pulled spray rig with boom; (4) backpack sprayer (hand-held wick); (4) capsule implantation, and (5) broadcast spreader. For some pesticides, different combinations of pesticide and application method are being proposed to give Provolt flexibility in addressing specific management needs that may occur. Each method is described briefly in the following paragraphs.

High-Pressure Hydraulic Sprayer. High-pressure hydraulic sprayers consist of a powered pump and tank carried by truck or tractor, and hand-held nozzles for dispersing the solution upward into the tree. These sprayers could be used to treat individual mature trees with the insecticides chlorpyrifos, diazinon, esfenvalerate, permethrin, horticultural oil, or propargite; or with the fungicide chlorothalonil.

Hydraulic Sprayer with Hand-Held Wand. A spray tank is mounted on a truck, tractor, or all-terrain vehicle (ATV), and may be used to apply herbicides around trees in orchard units, along fence-lines, and as a spot treatment in fallow fields, orchard units, and administrative areas. The sprayer may be operated by one worker, who drives and stops to spray, or by two workers, with one driving and the other spraying. This method may be used to apply the insecticides chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, or propargite; the fungicide chlorothalonil; or the herbicides dicamba, glyphosate, or picloram.

Tractor-Pulled Spray Rig with Boom. This method may be used to apply herbicides for control of weeds in orchard units, in roadways, or in fallow areas. Equipment consists of a hydraulic spray tank pulled by a tractor or heavy-duty pickup truck, with a spray boom attached to the tank to release the herbicide. At Provolt, this method may be used to apply the herbicides glyphosate or dicamba.

Backpack Sprayer. A backpack sprayer consists of a plastic tank containing the pesticide that is strapped to the applicator's back. A hand-operated hydraulic pump forces the liquid from the tank through a nozzle in a hand-held wand. At Provolt, a backpack sprayer could be used to apply the insecticides dimethoate, esfenvalerate, permethrin, or propargite; or herbicides dicamba, glyphosate, or picloram, for treatment of unwanted vegetation in orchard units and along fence lines.

Hand-Held Wick. A hand-held wick consists of a stick containing diluted herbicide in contact with an absorbent material (a rope or wick pad), which is then wiped directly on the

foliage of target vegetation. At Provolt, this method may be used to apply dicamba or glyphosate for spot treatment of weeds.

Capsule Implantation. The insecticides acephate and imidacloprid may be implanted into individual trees for long-term control of insect pests in the form of a capsule. One small hole is drilled into a tree for every 4 inches of circumference, and a capsule is inserted.

Broadcast Spreader. Fertilizers may be distributed over the ground using a spreader pulled by a truck, or mounted on a tractor or ATV. Broadcast or sidecast spreaders would be used for general fertilizer (nitrogen/phosphorus/sulfate) applications. Sidecast or drop spreaders would be used to apply calcium nitrate to the dripline of trees for stimulating flower production.

Rate/Frequency/Volume and Locations of Applications. The BLM provided application data for each pesticide, herbicide and fertilizer proposed for use at Provolt over the proposed five-year term of the consultation. Table 3 details the data for diazinon, esfenvalerate, and dimethoate, and is included here as an example of data provided for all pesticide, herbicide and fertilizer in the BA. Table 3 lists the proposed no-application buffers at Provolt. All of the tables can be viewed within the BA.

Table 3. Pesticide and Herbicide Application Data - Provolt

Application Method	Location	Typical Application Rate and Area	Max. Label Application Rate and Max. Area	Application Date Range	Anticipated Frequency
Diazinon: Diazinon 50W (50% a.i. as a wettable powder) *Target pests: ants, spiders, moths, aphids, mites, or other serious insect outbreaks in the administrative and landscaping areas, or in isolated orchard locations when small but serious insect damage needs attention*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Individual trees in any production orchard unit	0.015 lb a.i./tree, in water at 3 gal/tree 1 application to 100 trees on 20 acres	0.075 lb a.i./tree, in water at 5 gal/tree 1 application to 300 trees on 20 acres and an additional application to 150 trees on 10 acres	Apr - Sept	Seldom: 1 to 2 times in a 5-year period
Dimethoate: Digon 400 (43.5% a.i. as a liquid concentrate) *Target pests: Douglas-fire cone gall midge*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard unit	0.13 lb a.i./tree, in water at 2 gal/tree 1 application to 500 trees	0.34 lb a.i./tree, in water at 4 gal/tree 2 applications to 500 trees	Apr - Sept	1 to 2 times in a 5-year period

Application Method	Location	Typical Application Rate and Area	Max. Label Application Rate and Max. Area	Application Date Range	Anticipated Frequency
Esfenvalerate: Asana® XL (8.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir cone worm, western conifer seed bug, Douglas-fir seed chalcid, Douglas-fir cone moth, Douglas-fir cone gall midge*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard unit	0.001 lb a.i./tree, in water at 2 gal/tree 2 applications to 1,700 trees	Cumulative maximum = 1.6 lb a.i./acre per year 0.002 lb a.i./tree, in water at 4 gal/tree 2 applications to 1,700 trees	Apr - Jul	annual

Table 4. Proposed Minimum No-Application Buffers - Provolt

Compound	Application Method	Minimum Stream Buffer (ft)
B.t. Chlorothalonil Chlorpyrifos Diazinon Esfenvalerate Horticultural oil Permethrin Potassium salts of fatty acids Propargite	High-pressure hydraulic sprayer	90
Dicamba Glyphosate Picloram	Tractor-pulled spray rig with boom	40
B.t. Chlorothalonil Chlorpyrifos Diazinon Dicamba Dimethoate Esfenvalerate Glyphosate Permethrin Picloram Potassium salts of fatty acids Propargite	Hydraulic sprayer with handheld wand	40

Compound	Application Method	Minimum Stream Buffer (ft)
Dicamba Dimethoate Esfenvalerate Glyphosate Permethrin Picloram Potassium salts of fatty acids Propargite	Backpack sprayer	40
Dicamba Glyphosate	Hand-held wick	20
Acephate Imidacloprid	Capsule implantation	40
Fertilizers	Broadcast spreader	40

Annual Monitoring and Reporting Requirements

The BLM proposed a methodology for water quality monitoring whenever a pesticide or fertilizer covered under the BA is proposed for use. The plan covers four types of monitoring: (1) Implementation monitoring; (2) effectiveness monitoring; (3) validation monitoring, and (4) compliance monitoring.

The overall objective of the monitoring program at Provolt is to document the impacts of IPM actions on water quality, and to use this information to continue or modify the protection measures needed to meet the requirements for a healthy aquatic ecosystem. A full assessment of protection measures used in Provolt requires monitoring both groundwater and surface water.

Implementation Monitoring. All pesticide, herbicide, and fertilizer applications would be documented by Provolt's manager or designated representative. Items to be documented include: (1) The type of chemical applied; (2) the date of application; (3) the method of application; (4) the area treated, the amount applied; (5) precipitation amounts for the three days preceding and following application; (6) the location used for mixing and loading; (7) wind direction and speed; (8) relative humidity and air temperature; and (9) notes regarding whether any leakage or spills occurred. A list of all protection measures and limitations for each orchard unit receiving pesticide or fertilizer application will all be provided in the Annual Provolt Monitoring Report.

Implementing protection measures and analyzing monitoring data of all types depends heavily on quality climate information. Maintenance of the existing seed orchard weather stations will continue providing real-time climate data including air temperature, precipitation, wind speed, wind direction, and relative humidity. These data will provide documentation of compliance and information to predict runoff patterns for effectiveness and validation monitoring.

Effectiveness Monitoring of CPs.

Drift Card Monitoring. All orchard units planned for high-pressure hydraulic sprayer applications of chemicals and beside flowing streams will have spray cards placed, such that drift from the application can be captured and characterized. Orchard units or treatment areas directly beside open water (within 100 feet) will require drift cards be placed at a maximum of 100-foot intervals along the edge of the Provolt unit before the application. If open canopy occurs in the waterway buffer, drift cards will be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Immediately after the application, the cards will be collected and reviewed to determine if a drift signature is present, the extent of the drift, and the potential for aquatic contamination. A copy of all the cards will be kept on file at the seed orchard along with a record of their location and all compliance monitoring documentation.

Surface Water Monitoring. For high-pressure hydraulic sprayer applications of chemicals, water samples will be collected before and after spray application as per Oregon Department of Forestry (ODF) (1997) protocols and site-specific 'time of concentration' measurements. Selection of sampling stations for surface water sampling will be based on the proximity to application areas.

All data will be used in conjunction with the spray cards to determine the effectiveness of the full 'suite' of protective measures implemented to avoid drift. Samples will be analyzed at a state-certified laboratory that has detection limits of 0.02 parts per billion (ppb) for most of the potential pesticides. Samples will be collected in accordance with laboratory instructions. When sites are sampled, additional interpretive data will be collected for pH, specific conductance, turbidity, and temperature.

Surface Runoff Monitoring. Pesticide and fertilizer fate modeling from the risk RA indicates that field runoff events within the first six months after spray application have the highest probability for carrying detectible concentrations of chemicals. One study (Rashin and Graber 1993) determined that runoff events within the first 72 hours of application were the most important in terms of increases in detectible pesticide concentrations. Effectiveness monitoring of protective measures and limitations in the proposed action will target those periods of precipitation that could result in field surface runoff and increased streamflow. These periods are most likely to carry the greatest detectible concentrations of chemicals. If a runoff event occurs after spring applications, these events will be sampled.

Continuous flow recording stations will be established to collect water and suspended sediment samples on a flow-weighted basis with the intention of providing individual storm concentrations for multiple runoff events. The data from recording stations will represent water quality conditions as a result of the effectiveness of implemented protection measures and limitations in the higher-risk seed production orchard units.

Semi-permeable membrane devices (SPMDs) may be used in addition to, or in lieu of, the flow-weighted concentration sampling (see details of SPMD use in the Cumulative Concentrations of Runoff discussion, below).

All data will be used in conjunction with continuous recorded climate data to evaluate the effectiveness of protection measures and limitations in minimizing introduction of pesticides and fertilizers to the aquatic system. Samples will be analyzed at a state-certified laboratory that has detection limits of 0.02 ppb for most of the potential pesticides. Samples will be collected in accordance with laboratory instructions.

Subsurface Runoff Monitoring. Monitoring will provide an indication of the buffer area effectiveness, and over time will provide information for future pesticide applications with the use of buffer areas.

Cumulative Concentrations Runoff. Stormflow with the highest potential for chemical presence will be sampled and, during these flow events, samples will often be composited according to the rise and fall of the hydrograph, which in turn can obscure concentrations.

In an effort to address these issues and answer the cumulative effects question, SPMDs will be deployed, to monitor the accumulation of chemicals in waters containing aquatic species. The SPMD is an instream 'accumulator' which allows calculation of an average chemical concentration during the period of deployment. As such, the SPMDs will only be deployed during the initial fall/winter storms and spring storm periods after pesticide application.

Stream flow gauges (United States Geological Survey [USGS] and BLM) will be maintained to provide flow data for deriving concentrations (chemical loading) over the period of time the SPMD is deployed. Data from the SPMD concentrations will be used to compare and validate the storm flow concentration monitored during the deployment period.

Monitoring Related to Modeled Concentrations. Validation monitoring is intended to verify the water quality modeling predictions presented in the EIS. Monitoring the stream systems will identify the effectiveness of protection measures, and to help to gauge the estimates in the RA.

Collection chambers will be installed in areas where there are concerns regarding overland flow. During the first overland flow event following select chemical applications, these sites will be visited, and a water sample taken from the collection chamber. Once the first surface runoff event is captured and results become available, the need to sample later runoff events will be determined based on concentrations detected. In the short term, these data will be used to assess the mobility of chemicals with high aquatic toxicity. Concentrations will be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.

Stream concentrations will also be compared to model results using actual application information, field-specific data, and continuous climate record. These data will provide a

relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period will be used to model a predicted concentration using the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS)[3] and Method of Characteristics (MOC)[4] models. These concentrations will be 'diluted' using the continuous flow data from the station. The resulting concentrations will be compared with the actual measured concentrations for each storm event sampled.

Compliance Monitoring.

Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics such as toxicity and mobility, will be evaluated to determine if water sampling is desirable and necessary. If so, water samples will be collected in a sufficient number and at surface water and groundwater locations that will allow characterization of impacts and effective remediation methods. At a minimum, sampling will be conducted in the streams draining the spill area and the immediate groundwater table, if present. If in proximity to the spill, the orchard domestic well will also be sampled.

A spill prevention plan will be developed before any pesticide applications, and be part of Provolt's Pesticide Safety Plan. The spill prevention plan will minimize or eliminate the risk of a pesticide spill for any pesticide operation. Provolt will develop a model or general pesticide spill plan which will address concerns and identify such factors as: (1) Critical sites where spills will likely occur, such as narrow road or stream/waterway crossings, soft soil or roadway areas, and rough roads; (2) mechanical or operational requirements, such as tire tread to reduce blowouts, speed limits at critical roadway curves or other areas, and quantity carrying capacity of tanks/vehicles at safe levels to prevent roll-overs and sloshing; (3) environmental restrictions, such as rainfall limits and standing water limits; and (4) approved mixing sites.

At the operational level, the plan will include specific routes of the equipment, load limits for equipment, allowable speeds on the routes, mixing site limits in quantities, chemical types, or spill potential.

Groundwater Monitoring. The domestic and irrigation wells will be monitored according to the parameters outlined by the Oregon Department of Health. Two irrigation/domestic wells and one proposed test well at Provolt are available for monitoring tests. Water samples for pesticides could be taken from the wells on a yearly basis during the maximum well usage. The pesticide chosen will vary according to the rates, persistence, and

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[3] The GLEAMS model, developed by the USDA Agricultural Research Service, is a computerized mathematical model developed for field-sized areas to evaluate the movement and degradation of chemicals within the plant root zone under various crop management systems. The model has been tested and validated using a variety of data on pesticide movement. A more detailed discussion of the GLEAMS model can be found in the Provolt RA Sec 3-13.

[4] MOC is a two-dimensional groundwater flow and chemical transport model, developed by the U.S. Geological Survey and is designed to account for the attenuating affect of buffer zones.

mobility of the pesticides applied during the period since the last sampling. These samples will be handled according to state-certified laboratory instructions, and collected in late summer.

Annual Reporting. All water quality monitoring information associated with application of the Provolt Seed Orchard's IPM program will be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' will include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, will be contained in an Annual Provolt Monitoring Report. This report will be available to the public and regulatory agencies on November 15 of each year and will be on file at Provolt. BLM will request that NMFS' review of this Plan be completed by January 15 of the following year. This schedule will provide for timely inclusion of monitoring results in the Annual Operating Report and inclusion of the full period of runoff during the fall/winter period and planning for the upcoming budget year.

Framework for Multi-Year Consultation

In light of the dynamic nature of new scientific data, parallel section 7 consultations with EPA, and legal actions and decisions regarding pesticides summarized above, the BLM included within the proposed action a methodology to facilitate multi-year consultation on the proposed project, as necessary, using the following process:

1. The BLM will submit an Annual Operation Report to NMFS with the following information:

   a. A description of pesticide applications conducted over the reporting period.
   b. The results of the previous year monitoring program.
   c. A literature review of the pesticides that are proposed for use at Provolt the following year. There may be a single review covering pesticides proposed at all four seed orchards. The review will include new scientific data regarding non-target fish species effects or environmental fate, changes to EPA-approved labels, and legal findings relevant to the use of the pesticides. Any new data will be considered in terms of effects on seed orchard use as proposed in the BA and on the conclusions of the EIS RA.
   d. A plan for proposed pesticide applications for the following year, including, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored. This plan will note that it may be possible for the seed orchard manager to schedule some applications, such as roadside vegetation management or insecticides for cone and seed insects in units that will be harvested to meet specific seed needs, in advance, and they will be fully described. However, the seed orchard manager will have the flexibility to use any of the applications as described in Table 3-1 of the BA, to respond to unforeseen pest management needs (for example, detection of disease or an insect infestation).

e. Any proposed changes to the selected alternative as described in the EIS and Record of Decision (ROD), including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those listed in Table 3-1; or other relevant information.

2. A new BA providing an updated effects analysis will be submitted to NMFS with the annual Operation Report if the literature review:

a. Identifies new scientific data or labeling details indicating additional possible effects to listed species.
b. Identifies proposed changes to the selected alternative as described in the EIS and ROD.
c. Determines that monitoring data following pesticide applications indicate that effects are greater than anticipated.

Approach to Finding New Information on Pesticides Proposed for Use at Provolt. Before the analysis phase begins, the BLM will identify the relevant technical literature for the pesticide or pesticides in question. The ESA requires that Federal agencies use the best scientific and commercial data available (50 C.F.R. 402. 14[d]). This section provides an overview of search and acquisition strategies that can be used to identify peer-reviewed data and other forms of scientific evidence that may be relevant to Pacific salmon and steelhead.

Online Scientific Databases. The literature search for each active ingredient, as well as inert ingredients, adjuvants, surfactants and degradates will include keyword-based queries of several scientific databases. In addition to EPA's ECOTOX database, the targeted databases will include Aquatic Sciences and Fisheries Abstracts, Medline, Web of Science, AGRICOLA, Chem Abstracts, and BIOSIS. The searches will also be supplemented with literature abstracting databases including Toxline, Toxnet, and Current Contents: Agriculture, Biology, and Environmental Sciences.

Keywords. Scientific databases will be searched with keywords that are specific to fish or known invertebrate prey species for salmon or steelhead.[5]

Paper-Based Searches. Paper-based searches of bibliographies, guidance documents, modeling studies, and review articles will be conducted to identify primary sources of relevant

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[5] For fish, all keywords, or an appropriate subset, will include *salmonid, Chinook salmon, coho salmon, steelhead salmon, chum salmon, sockeye salmon, pink salmon, Atlantic salmon, cutthroat trout, bull trout, rainbow trout, char, Oncorhynchus mykiss, O. tshawytcha, O. kisutch, O. nerka, O. gorbuscha, O. clarkii, Salmo, Salvelinus, alevin, fry, parr, smolt, and fish*. For potential impacts to invertebrate prey species, all keywords, or an appropriate subset, will include *chironomid, mayfly, stonefly, copepod, amphipod, mysid, cladoceran, Chironimidae, Simuliidae, Ephemeroptera, Plecoptera, Neoptera, Trichoptera, Copepoda, Diptera, Gammaridae, Daphnia*. For potential impacts on primary production in aquatic systems, all keywords, or an appropriate subset, will include *algae, diatom, periphyton, Chlorella, and Selenastrum*. Additional keywords may be used as appropriate. For each pesticide, the active ingredient, inert ingredient(s), adjuvant, surfactant, degradate(s), product name(s), and Chemical Abstract Registry Number (CAS RN) will be used in the database search.

scientific information. In addition, data provided in support of pesticide registrations will be considered.

Other Actions Not Covered Under the BA. Herbicide use for competing vegetation (non-noxious applications) are not covered in this Opinion.

Action Area

'Action area' means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 C.F.R. 402.02). For purposes of this consultation, the action area for this consultation begins at the Applegate River beside and downstream from Provolt, and includes the lower portion of Williams Creek as it flows into the Applegate River. The downstream portion of the action area extends to the confluence of the Applegate River and the Rogue River below Provolt.

The action area is used by SONC coho salmon for all life history stages, and is designated as critical habitat. The project area is also designated as EFH for Pacific Coast salmon (PFMC 1999), or is in an area where environmental effects of the proposed project may adversely affect designated EFH for those species.

ENDANGERED SPECIES ACT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with USFWS and NMFS, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats.

Section 9(a)(1) and protective regulations adopted pursuant to section 4(d) of the ESA prohibit the 'taking' of listed species without a specific permit or exemption. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). 'Incidental take' refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

Biological Opinion

This Opinion presents NMFS' review of the status of the evolutionary significant unit (ESU)[6] considered in this consultation and critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects. An analysis of those combined factors is used to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESUs, or is likely to destroy or adversely modify designated critical habitat (50 C.F.R. 402.14(g)). If the action under consultation is likely to jeopardize the ESU, or destroy or adversely modify designated critical habitat, NMFS must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 CFR 402.02).

Status of the ESU

This section defines range-wide biological requirements of each ESU, and reviews the status of the ESU relative to those requirements. The present risk faced by each ESU informs NMFS' determination as to whether additional risk would 'appreciably reduce' the likelihood of both survival and recovery in the wild. The greater the present risk, the more likely any additional risk resulting from the proposed action's effects on the population size, trend (growth rate), distribution, and genetic diversity of the listed species would be an appreciable reduction (McElhaney *et al.* 2000).

Coho Salmon. Coho salmon is a widespread species of Pacific salmon, occurring in most major river basins around the Pacific Rim from Monterey Bay in California, north to Point Hope, Alaska, through the Aleutians, and from the Anadyr River south to Korea and northern Hokkaido, Japan (Laufle *et al.* 1986). From central British Columbia south, the vast majority of coho salmon adults are 3-year-olds, having spent approximately 18 months in freshwater and 18 months in saltwater (Gilbert 1912; Pritchard 1940; Sandercock 1991). The primary exceptions to this pattern are 'jacks,' sexually mature males that return to freshwater to spawn after only 5 to 7 months in the ocean. However, in southeast and central Alaska, the majority of coho salmon adults are 4-year-olds, having spent an additional year in freshwater before going to sea (Godfrey *et al.* 1975; Crone and Bond 1976). The transition zone between predominantly 3-year-old and 4-year-old adults occurs somewhere between central British Columbia and southeast Alaska.

With the exception of spawning habitat, which consists of small streams with stable gravels, summer and winter freshwater habitats most preferred by coho salmon consist of quiet areas with low flow, such as backwater pools, beaver ponds, dam pools, and side channels (Reeves *et al.*

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[6] 'ESU' means an anadromous salmon or steelhead population that is either listed or being considered for listing under the ESA, is substantially isolated reproductively from conspecific populations, and represents an important component of the evolutionary legacy of the species (Waples 1991). An ESU may include portions or combinations of populations more commonly defined as stocks within or across regions.

1989). Habitats used during winter generally have greater water depth than those used in summer, and also have greater amounts of large woody debris. West Coast coho smolts typically leave freshwater in the spring (April to June) and re-enter freshwater when sexually mature from September to November and spawn from November to December and occasionally into January (Sandercock 1991). Stocks from British Columbia, Washington, and the Columbia River often have very early (entering rivers in July or August) or late (spawning into March) runs in addition to 'normally' timed runs.

The status of coho salmon for purposes of ESA listings has been reviewed many times, beginning in 1990. The first two reviews occurred in response to petitions to list coho salmon in the Lower Columbia River and Scott and Waddell Creeks (Central California) under the ESA. The conclusions of these reviews were that NMFS could not identify any populations that warranted protection under the ESA in the Lower Columbia River (Johnson *et al.* 1991), and that the Scott and Waddell Creeks' populations were part of a larger, undescribed ESU (Bryant 1994).

A review of West Coast (Washington, Oregon, and California) coho salmon populations began in 1993 in response to several petitions to list numerous coho salmon populations and NMFS' own initiative to conduct a coastwide status review of the species. This coastwide review identified six coho salmon ESUs, of which the three southern-most were proposed for listing, two were candidates for listing, and one was deemed 'not warranted' for listing (Weitkamp *et al.* 1995). In October 1996, the Biological Review Team (BRT) updated the status review for the Central California (CC) ESU, and concluded that it was at risk of extinction (NMFS 1996a). In October 1996, NMFS listed this ESU as threatened on May 6, 1997 (62 FR 24588), protective regulations were applied on July 18, 1997 (62 FR 68479), and critical habitat was designated on May 5, 1999 (64 FR 24049).

In December 1996, the BRT updated the status review update for both proposed and candidate coho salmon ESUs (NMFS 1996b). However, because of the scale of the review, comanagers' requests for additional time to comment on the preliminary conclusions, and NMFS' legal obligations, the status review was finalized for proposed coho salmon ESUs in 1997 (NMFS 1997), but not for the candidate ESUs. In May 1997, NMFS listed the SONC ESU as threatened, while it announced that listing of the Oregon Coast (OC) ESU was not warranted due to measures in the Oregon Coho Salmon Restoration Initiative (OCSRI) plan. This finding for OC coho was overturned in August 1998, and the ESU listed as threatened.

The process of updating the coho salmon status review was begun again in October 1998 for coho salmon in Washington and the Lower Columbia River. However, this effort was terminated before the BRT could meet, due to competing activities with higher priorities.

In response to a petition by Oregon Trout *et al.* (2000), the status of Lower Columbia River (LCR) coho salmon was revisited in 2000, with BRT meetings held in March and May 2001 (NMFS 2001a). The BRT concluded that splitting the LCR/Southwest Washington coast ESU to form separate LCR and Southwest Washington coast coho salmon ESUs was most consistent

with available information and the LCR ESU was at risk of extinction. Like the 1996 status review update, these results were never finalized.

The coho salmon BRT met in January, March and April 2003 to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRTs.

Southern Oregon/Northern California Coasts (SONC) Coho Salmon. The SONC coho salmon ESU extends from Cape Blanco in southern Oregon, to Punta Gorda in northern California (Weitkamp *et al.* 1995). The status of coho salmon coastwide, including the SONC coho ESU, was formally assessed in 1995 (Weitkamp *et al.* 1995). Two subsequent status review updates have been published by NMFS, one addressing all West Coast coho salmon ESUs (NMFS 1996b) and a second specifically addressing the OC and SONC ESUs (NMFS 1997).

In the 1995 status review, the BRT was unanimous in concluding that coho salmon in the SONC coho ESU were not in danger of extinction but were likely to become so in the foreseeable future if present trends continued (Weitkamp *et al.* 1995). In the 1997 status update, estimates of natural population abundance in this ESU were based on very limited information. Favorable indicators included recent increases in abundance in the Rogue River and the presence of natural populations in both large and small basins, factors that may provide some buffer against extinction of the ESU. However, large hatchery programs in the two major basins (Rogue and Klamath/Trinity) raised serious concerns about effects on, and sustainability of, natural populations.

New data on presence/absence in northern California streams that historically supported coho salmon were even more disturbing than earlier results, indicating that a smaller percentage of streams in this ESU contained coho salmon compared to the percentage presence in an earlier study. However, it was unclear whether these new data represented actual trends in local extinctions, or were biased by sampling effort. This new information did not change the BRT's conclusion regarding the status of the SONC coho ESU. Although the OCSRI proposals were directed specifically at the Oregon portion of this ESU, the harvest proposal would affect ocean harvest of fish in the California portion as well. The proposed hatchery reforms can be expected to have a positive effect on the status of populations in the Rogue River Basin. However, the BRT concluded that these measures would not be sufficient to alter the previous conclusion that the ESU is likely to become endangered in the foreseeable future.

One effect of the OCSRI has been increased monitoring of salmon and habitats throughout the Oregon coastal region. Besides continuation of the abundance data series analyzed in the 1997 status update, Oregon has expanded its random survey monitoring to include areas south of Cape Blanco, including monitoring of spawner abundance, juvenile densities, and habitat condition.

New data for the SONC coho salmon ESU includes expansion of presence-absence analyses, a limited analysis of juvenile abundance in the Eel River Basin, a few indices of spawner

abundance in the Smith, Mad, and Eel River Basins, and substantially expanded monitoring of adults, juveniles, and habitat in southern Oregon. None of these data contradict conclusions reached previously by the BRT. Nor do any of recent data (1995 to present) suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONC coho ESU. Coho salmon populations continued to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Although the 2001 broodyear appears to be the one of the strongest perhaps of the last decade, it follows a number of relatively weak years. The Rogue River stock is an exception; there has been an average increase in spawners over the last several years, despite two low years (1998, 1999).

Risk factors identified in previous status reviews, including severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that are clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continue to be of concern to the BRT. Termination of hatchery production of coho salmon at the Mad River and Rowdy Creek facilities has eliminated potential adverse risk associated with hatchery releases from these facilities. Likewise, restrictions on recreational and commercial harvest of coho salmon since 1994 have undoubtedly had a substantial positive impact on coho salmon adult returns to SONC streams. An additional risk factor that has been identified within the SONC coho ESU is predation resulting from the illegal introduction of non-native Sacramento pikeminnow (*Ptychocheilus grandis*) to the Eel River Basin (NMFS 1998). Sacramento pikeminnow were introduced to the Eel River via Pillsbury Lake in the early 1980s, and have subsequently spread to most areas within the basin. The rapid expansion of pikeminnow populations is believed to have been facilitated by alterations in habitat conditions, particularly increased water temperatures, that favor pikeminnow (Brown *et al.* 1994; NMFS 1998).

A majority (67%) of BRT votes fell into the 'likely to become endangered' category, while votes in the 'endangered' category outnumbered those in the 'not warranted' categories by 2-to-1. The BRT found moderately high risks for abundance and growth rate/production, with mean matrix scores of 3.5 to 3.8, respectively, for these two categories. Risks to spatial structure and diversity were judged by the BRT to be moderate.

The BRT remained concerned about low population abundance throughout the ESU relative to historical numbers and long-term downward trends in abundance; however, the paucity of data on escapement of naturally-produced spawners in most basins continued to hinder assessment of risk. A reliable time series of adult abundance is available only for the Rogue River. These data indicate that long-term (22-year) and short-term (10-year) trends in mean spawner abundance are upward in the Rogue; however, the positive trends reflect effects of reduced harvest (rather than improved freshwater conditions) since trends in pre-harvest recruits are flat. Less-reliable indices of spawner abundance in several California populations reveal no apparent trends in some populations and suggest possible continued declines in others.

Additionally, the BRT considered the relatively low occupancy rates of historical coho salmon streams (between 37% and 61% from broodyear 1986 to 2000) as an indication of continued low

abundance in the California portion of this ESU. The relatively strong 2001 broodyear, likely the result of favorable conditions in both freshwater and marine environments, was viewed as a positive sign, but was a single strong year following more than a decade of generally poor years.

The moderate risk matrix scores for spatial structure reflected a balancing of several factors. On the negative side was the modest percentage of historical streams still occupied by coho salmon (suggestive of local extirpations or depressed populations). The BRT also remains concerned about the possibility that losses of local populations have been masked in basins with high hatchery output, including the Trinity, Klamath, and Rogue systems. The extent to which strays from hatcheries in these systems are contributing to natural production remains uncertain; however, it is generally believed that hatchery fish and progeny of hatchery fish constitute the majority of production in the Trinity River, and may be a significant concern in parts of the Klamath and Rogue systems a well. On the positive side, extant populations can still be found in all major river basins within the ESU. Additionally, the relatively high occupancy rate of historical streams observed in broodyear 2001 suggests that much habitat remains accessible to coho salmon. The BRT's concern for the large number of hatchery fish in the Rogue, Klamath, and Trinity systems was also evident in the moderate risk rating for diversity.

Coho Salmon Habitat Use in the Action Area. Various life-stages of coho are likely to be in Williams Creek and the Applegate River throughout the year. In addition, some juveniles may be present in the various irrigation ditches within Provolt's boundary. Though spawning near Provolt will not likely be widespread, coho may nonetheless spawn within the action area. Coho salmon eggs incubate in gravel redds in rivers, then hatch as the larval stage called alevins, which depend on food stored in a yolk sac. After the yolk sac is absorbed, juvenile coho emerge from the gravel nest as fry during late winter/early spring. Juvenile coho rear in slow fresh water habitats for one year, after which they migrate to the ocean as smolts. Coho smolts typically migrate to sea in the spring, spend 16 to 20 months rearing in the ocean, then return to freshwater as adults in the fall and spawn from October to January. Adult coho salmon will migrate above stream segments with cascades or rapids if an unconstrained or low-gradient stream segment with suitable spawning habitat is present upstream.

As displayed in Table 5, coho salmon in the action area likely spend one year in freshwater and eighteen months in saltwater. Variation from this pattern does occur, with some juvenile coho spending a second summer in freshwater areas.

Table 5. Coho Salmon Use in Williams Creek and the Applegate River and Tributaries

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Adult Immigration /Holding									■	■	■	■
Adult Spawning	■								■	■	■	■
Incubation/ Emergence	■	■	■	■						■	■	■
Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile emigration		■	■	■	■							

Shaded months indicate particular lifestage use.

Environmental Baseline

The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. 402.02). For projects that are ongoing actions, the effects of all past actions are part of the environmental baseline and the effects of future actions over which the Federal agency has discretionary involvement or control will be analyzed as 'effects of the action.'

Analysis of the environmental baseline is guided by the specific habitat components necessary to support SONC coho in the action area. When the environmental baseline departs from conditions that support those biological requirements, it becomes more likely that additional risk to the ESU resulting from the effects of the proposed action on the ESU or its habitat will result in jeopardy (NMFS 1999). The biological requirements of SONC coho in the action area vary depending on the life history stage present and the natural range of variation present within that system (Groot and Margolis 1991; NRC 1996; Spence *et al.* 1996).

Generally, during spawning migrations, adult salmon require clean water with cool temperatures or thermal refugia, dissolved oxygen near 100%, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Spawning areas are selected based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*i.e.*, gravel size, porosity, permeability, and oxygen levels), substrate

stability during high flows, and, for most species, water temperatures of 13˚C or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether ocean, lakes, or other stream reaches, requires unobstructed access to these habitats. Physical, chemical, and thermal conditions may all impede migrations of adult or juvenile fish.

The SONC coho ESU considered in this Opinion resides in or migrates through the action areas. Thus, for this action area, the biological requirements for SONC coho are the habitat characteristics that would support successful migration, spawning, incubation, rearing and emigration.

The Provolt Seed orchard is in the Rogue River Basin at the confluence of the Applegate River and Williams Creek. The lower Applegate River is downstream from this confluence. Williams Creek flows near the western side of Provolt property and crosses through the property near the northern boundary. The Applegate River flows along the northern boundary of the property. Provolt contains three irrigation ditches and two small reservoirs. The Laurel Hill and Bridgepoint Ditch waters are both diverted from the Applegate River. Spencer Ditch flows north through the southern part of the property where it joins the Bridgepoint Ditch. There is another small reservoir on Provolt in the south-central part of the property that is the water source for Spencer Ditch. This reservoir originates from runoff and from a small tributary from the southeast.

The Applegate River originates from the northeast corner of the Siskiyou Mountains of southwestern Oregon, and drains into the Rouge River at RM 95. The Rogue River Basin drains 5,058 square miles in southwestern Oregon and northern California. The Rogue River flows west from the headwaters in the Cascades near Crater Lake, through interior valleys and Coast Range mountains of southwest Oregon, to the Pacific Ocean. The Rogue system has two main dams managed by the U.S. Army Corps of Engineers, several large diversion impoundments, and hundreds of smaller water diversions affecting fish distribution. The dams have significantly altered the natural flow and temperature regime, and impaired fish passage and distribution in the Rogue River Basin.

The Applegate Watershed is approximately 494,209 acres, and covers several different management areas including: Forest Service, BLM, and state lands; private agricultural and forestry land; and urban development. The Applegate Valley is characterized by forest stands, groves, and oak savannas (Franklin and Dyrness 1973). The Applegate River is water-deficient, primarily due to the water demand for urban and irrigation use. The hydrology in the Applegate River above the project site is influenced by dams and irrigation ditch systems. Applegate River Dam, upstream from the seed orchard, controls flows in the Applegate River. Further, scattered temporary push-up dams are constructed within the Applegate River during the irrigation season, which divert significant volumes of water to adjacent agricultural lands.

The Williams Creek Watershed has steep mountainous slopes and a flat valley floor. It has broad valleys, and low gradient, meandering channels, with a dominant bed material of gravel.

The drainage area is 52,944 acres, and the average discharge is estimated to be 92.5 cfs. A NMFS matrix of pathways and indicators (MPI) was prepared by the BLM for several baseline conditions in the Williams Creek Watershed. The BLM determined that no factors at Williams Creek currently are determined to be functioning properly. Factors identified as not functioning properly include the presence of human-caused barriers, change in peak/base flows, increase in drainage networks, high road density, disturbance history, and insufficient riparian reserves. All remaining conditions were determined to be at risk.

Water quality monitoring efforts within the Applegate River by Oregon's Department of Environmental Quality shows degraded water quality regarding temperature and flow modification. The BA summarizes water quality conditions in these two waterways as follows:

> The Applegate River receives return flows from irrigated agriculture and other uses. During high flow periods, the river exhibits high levels of fecal coliforms and biochemical oxygen demand. During the low flow summer months, high temperature, concentrated total solids, and biochemical oxygen demand work to deplete dissolved oxygen concentrations. It appears that non-point source pollution is contributing to a significant decrease in water quality in the Applegate River (ODEQ undated). Williams Creek is periodically impaired by phosphate and moderately impaired by dissolved oxygen and nitrate (Williams Creek Watershed Council 2000).
>
> Section 303(d) of the Clean Water Act requires states to list impaired waterbodies and determine allowable total maximum daily loads (TMDLs) that would provide for restoration of those impaired bodies. The list identifies those waterbodies that do not meet all applicable water quality standards necessary to protect beneficial uses. The 1998 ODEQ 303(d) list includes both the Applegate River and Williams Creek. The section of the Applegate River that flows past Provolt was listed for its high temperatures in the low flow summer months in 1998. Williams Creek was listed in 1998 for its high temperatures in the summer and in 2002 for dissolved oxygen (ODEQ 2002)(BLM 2004).

The 300-acre seed orchard is bordered by the mainstem Applegate River and bisected by Williams Creek as it flows into the Applegate. The BA summarizes the drainages at the Provolt orchard:

> The property contains three irrigation ditches and two small reservoirs. The Laurel Hill and Bridgepoint Ditch waters are both diverted from the Applegate River. The Laurel Hill Ditch starts near the northwestern portion of the property and flows across Williams Creek via a push-up dam. This ditch is used to irrigate three orchard units in the northwest portion of the property. The Bridgepoint Ditch originates from the Applegate River approximately five miles upstream from the orchard, near the town of Applegate. It flows into the orchard property at the southeast corner and flows northwest through the southern portion of the orchard until it crosses Williams Creek via a push-up dam and is diverted back into the ditch on the opposite bank. Bridgepoint Ditch provides water for

Stone Reservoir via a control gate to an underground pipe. Stone Reservoir is next to the orchard office and is an old farm pond that is only used for wildlife habitat. This pond has a volume of 4.5 acre-feet and has a control gate to manage outflows as needed. The outflow starts as a culvert and changes to a small ditch flowing east into the Applegate River.

Spencer Ditch, the third ditch, flows north through the southern part of the property where it joins the Bridgepoint Ditch. The southern area near Spencer Ditch is flooded in most wet winters from neighboring field and woodlot runoff; a bar ditch on the southwestern side of the property collects this water. Due to this flooding and a seasonally shallow water table, the southwestern orchard block, unit 13, is not planted now as an orchard unit but only as a cover crop.

There is another small reservoir on the orchard property in the south-central part of the orchard that is the source of water for Spencer Ditch. This reservoir originates from runoff and from a small tributary from the southeast. The runoff is captured in a bar ditch along the side of the county highway, joins the tributary, and flows into a culvert under the road and into the reservoir. The reservoir holds two acre-feet and the outflow is managed by a control gate with boards leading to Spencer Ditch (BLM 2004).

Aside from propagated conifer trees, there are few conifers within riparian areas of Provolt. Spencer, Laurel Hill, and Bridgeport irrigation ditches are managed to efficiently move water through Provolt. Vegetation along the ditches are limited to grasses that are kept relatively short through mowing. The irrigation ditches are dominated largely by blackberry species, cattails, rushes, sedges, teasel, and reed canary grass. The riparian forests are dominated by black cottonwood with subdominants including big-leaf maple, red alder, and Oregon ash. The forest understory is dominated by Himalayan blackberry. Other species in the forest understory include willow, climbing nightshade, wild grape, poison hemlock, and California smilax (*Smilax californica*).

Soils. Six types of soil are present at Provolt: (1) Banning loam, (2) Camas gravelly sandy loam, (3) Central Point sandy loam, (4) Newburg fine sandy loam, (5) Kerby loam, and (6) Takilma cobbly loam (SCS 1983, 1993). The cation exchange capacity of each of these soils is in the range of 5 to 25 milliequivalents per 100 grams (meq/100 g), indicating that they contain smectite clay and low to moderate amounts of organic matter, which adsorbs pesticides and fertilizers and retards their movement through the soil. Table 6 presents soil characteristics relevant to the environmental mobility of fertilizers and pesticides.

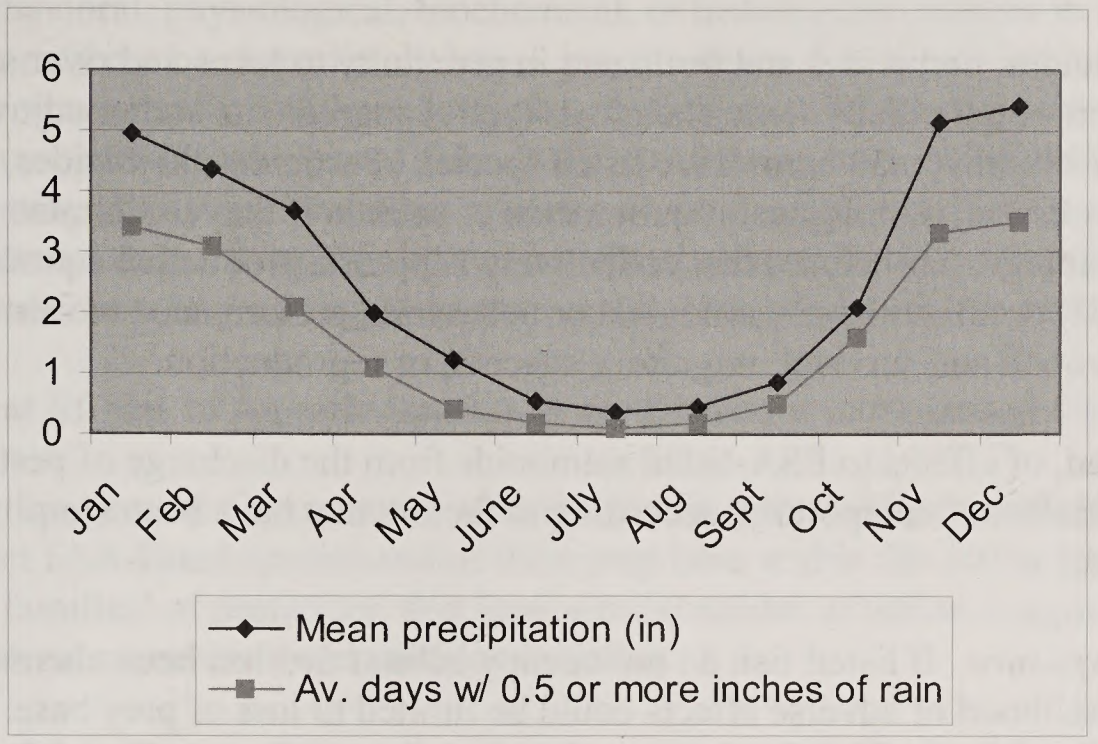
Table 6. Soil Characteristics at Provolt

Soil Series	Depth (inches)	Permeability (in/hr)	Depth to Water Table (ft)	Runoff	Slope (%)	Organic Matter (%)	Clay (%)	Soil Sensitivity
Banning	0 - 6	0.6 - 2	1- 3 (winter) >6 (summer)	slow	0 - 3	2 - 5	20 - 27	moderate
	6 - 60	0.2 - 0.6				0.1 - 2	27 - 35	
Camas	0 - 10	2 - 6	>6	slow	0 - 3	1 - 3	5 - 10	moderate
	10 - 60	20 - 101				0 - 1	0 - 5	
Central Point	0 - 15	2 - 6	4 (winter) >6 (summer)	slow	0 - 3	2 - 8	12 - 18	moderate
	15 - 36	2 - 6				0.5 - 2	12 - 18	
	36 - 60	2 - 6				0 - 0.5	8 - 13	
Newburg	0 - 15	2 - 6	>6	slow	0 - 3	2 - 4	7 - 15	moderate
	15 - 24	2 - 6				0.5 - 1	5 - 15	
	24 - 61	6 - 20				0.2 - 1	2 - 10	
Kerby	0 - 7	0.6 - 2	>6	slow	0 - 3	1 - 3	15 - 27	moderate
	7 - 40	0.6 - 2				0.5 - 1	18 - 27	
	40 - 60	6 - 20				0.2 - 0.5	5 - 15	
Takilma	0 - 6	2 - 6	>6	slow	0 - 3	2 - 4	15 - 23	moderate
	6 - 18	2 - 6				1 - 3	18 - 30	
	18 - 60	6 - 20				0.2 - 1	10 - 18	

Sources: SCS 1983, SCS 1993, OSUES 1998.

Weather. The average July temperature at Grants Pass is 69° F, the average January temperature is 39° F, and average annual precipitation is 31 inches. As illustrated in Figure 1, most of the precipitation occurs between the months of November and March; consistent with the frequent Pacific storm patterns.

Figure 1. Provolt Orchard Precipitation (BLM 2004)



Precipitation during the spring and summer months is typically very light. Annual average relative humidity ranges from a high of about 92%, typically in early morning, to a low of 26%, typically in the early afternoon. Winds are predominantly from the north to northwest throughout the months of December through August, and from the south from September through November.

Effects of the Proposed Action

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 C.F.R. 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, NMFS will evaluate the net combined effects of the proposed action and the offsite measures.

'Indirect effects' are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside the area directly affected by the action, and may include other Federal actions that have not undergone section 7 consultation but will result from the action under consideration. To be considered indirect effects, such actions must be reasonably certain to occur, as evidenced by appropriations, work plans, permits issued, or budgeting; follow a pattern of activity undertaken by the agency in the action area; or be a logical extension of the proposed action.
'Interrelated actions' are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 C.F.R. 402.02). Future Federal actions that are not a direct

effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this Opinion.

The application of pesticides, herbicides and fertilizers in proximity to lakes and river systems can result in the transport of potentially toxic chemicals (active ingredients and/or adjuvants) to surface waters (USGS 1999) that may harm ESA-listed species. Pesticides, herbicides, and fertilizers can impair the essential biological requirements of salmon if they undermine the physical, chemical, or biological processes that collectively support a productive aquatic ecosystem (Preston 2002) or affect the physiological or behavioral performance of salmonids in ways that will reduce growth and survival, migratory success, or reproduction.

The degree, or likelihood, of effects to ESA-listed salmonids from the discharge of pesticides to surface waters vary spatially and temporally, according to factors that have been simplified into the following categories:

1. *Likelihood of Exposure.* If listed fish do not occupy habitat that has been chemically modified, the likelihood of adverse effects could be limited to loss of prey base.[7]
2. *Water Quality Conditions*. Dissolved oxygen levels and temperature affect salmonids susceptibility to pesticide exposure.
3. *Lifestage of the Salmonid.* Salmonids occupy freshwater as incubating eggs/alevins, newly emerged fry, and rearing parr and smolts and as returning adults. Each lifestage has a different susceptibility or tolerance of exposure to pesticides.
4. *Levels of other Contaminants*. Concurrent discharge and/or background levels of other contaminants[8] can magnify adverse effects through mixture toxicity resulting from discharges associated with the IPM program.
5. *Concentration and relative toxicity of the chemical.*

Within the BA, the BLM evaluated expected effects from the pesticide portion of their IPM using models that assess potential delivery to aquatic systems from drift, surface runoff, and groundwater runoff. While these models are a viable analysis method to evaluate potential water concentrations, they generally do not account for many of environmental variables that can change the effects of pesticide applications. As applied, the models also did not account for the multitude of possible exposures that are proposed over the five-year implementation period. Background or concurrent delivery of pollutants from other sources, and degraded water quality within receiving waterways will add to the risk caused by pesticide delivery from BLM applications.

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[7] 'Prey base' refers to macroinvertebrates and aquatic plants that serve a food sources for juvenile salmonids. A loss of prey base upstream of areas occupied by ESA-listed salmon could result in decreased feeding opportunities downstream.

[8] Contaminants range from pesticides, herbicides and nutrients (phosphates and nitrates), to those associated primarily with road and urban runoff including heavy metals, and organics (i.e. oil and grease).

Most adverse effects to ESA-listed salmonids in the action area from the proposed IPM are likely to be sublethal. As stated in Rand (1995), sublethal effects to ESA-listed salmonids take the form of behavioral, physiological, biochemical, or histological changes in the exposed fish. These changes may not be immediately lethal, but can cause fish to exhibit impaired behaviors (*i.e.*, narcosis) or eventually develop a lower level of physical health, thus reducing their chances of survival as compared to unexposed fish. Possible consequences include loss of equilibrium, reduced swimming ability, and impaired predator avoidance behavior, which lead to increased predation risk and reduced foraging ability. Increased mixture toxicity between the pesticides and other contaminants in receiving waterways is likely to occur and exacerbate these effects.

General Effects to Aquatic Species From Exposure to Proposed Compounds

The following is a general discussion of effects from the proposed pesticides that are likely to adversely effect ESA-listed species and/or their prey base within the action area. Effects are presented by 'families' of pesticides, that have similar modes of action to aquatic species, and are based on literature reviews and published studies.

Organophosphates. Organophosphates are a group of closely-related pesticides that share a common mechanism of toxicity. The insecticides acephate, chlorpyrifos, diazinon, and dimethoate fall within this organophosphate category and are being proposed for use at Provolt. The central and peripheral nervous system is the primary target by disrupting the enzyme that hydrolyzes the nuerotransmitter acetylcholine. Inhibition of this enzyme, acetylcholinesterase, results in an accumulation of acetylcholine which has the effect of continuous stimulation of cholinergic and muscarinic receptors. Organophosphates are highly toxic to fish. Acetylcholinesterase inhibition can result in impairment of biological functioning such as growth, maturation, sensory systems and reproduction. Sublethal behavioral effects can include swimming, foraging, predator avoidance, and disruption of migratory behavior.

Acephate. Acephate is a contact insecticide that is applied to leaf surfaces of plants where it is eaten or comes in contact with pests. Acephate acts by inhibiting the enzyme acetylcholinesterase which is necessary for control of nerve transmission (USDA 1995). Acephate is very water soluble, very mobile in soils, and degrades rapidly in soils under aerobic conditions (EPA 2001). Acephate is considered slightly toxic to aquatic invertebrates and freshwater fish. A summary of toxicity values for aquatic life published in the literature for acephate is found in the Provolt RA. Provolt proposes to use Acecap® 97, which is 97% acephate in an implant capsule in Provolt units. There is no expected risk from capsule implantation to SONC coho.

Methamidophos. A degradate of acephate, is considered very highly toxic to aquatic invertebrates and slightly toxic to fish on an acute basis (EPA 2001). Acephate degrades to methamidophos in less than two days. This degradate has a slightly longer half-life (<10 days) (EPA 2001) and shares the high mobility of its parent compound. The BA predicted that acephate will reach water surface waters in negligible concentrations. This is probably due to its short anaerobic half-life, however, nothing is mentioned of its degradate. Methamidphos is

significantly more toxic to the prey base of salmonids, more persistent, highly mobile, and carries with it a greater potential for adversely affecting salmonid habitat.

Chlorpyrifos. Chlorpyrifos is very highly toxic to fish and aquatic invertebrates (USDA 1995b). A summary of toxicity values for aquatic life published in the literature for chlorpyrifos is found in the Provolt RA. When released into the environment, the half-life of chlorpyrifos ranged from 11 to 141 days in a variety of different soil types; it is thus considered to be moderately persistent (USDA 1995b). The potential for runoff into surface water could occur via erosion up to several months after application. Its degradate, TCP (3,5,6-trichloro-2-pyridinol) is a much more persistent chemical (>365 days) that exhibits much lower soil/water partitioning than chlorpyrifos and is highly water soluble. Within an area of continuous application, accumulated amounts of chlorypyrifos in the soil will eventually degrade into TCP. A storm event could mobilize TCP through dissolution in runoff water and be transported to surface water in a pulse like amount. However, TCP has been found to be much less toxic than chlorpyrifos to aquatic organisms (EPA 2000a).

Diazinon. Diazinon is very toxic to freshwater aquatic organisms and very highly toxic to aquatic invertebrates on an acute basis. A summary of toxicity values for aquatic life published in the literature for diazinon is found in the Provolt RA. Exposure to low concentrations (1 ppm or less) has been determined to cause genetic damage and disrupts behaviors that are crucial for reproduction and protection from predators (Cox 2000). Diazinon is moderately mobile in soils and persistent in the environment (37 to 39 days) (EPA 2001b). Diazinon is potentially of the most concern of the organophosphate group. There is a higher exposure probability and risk with more soluble pesticides with longer half-lives than less soluble pesticides with a shorter half-lives. Reduced populations of macro-invertebrates that may result from acute concentrations of diazinon, although temporary, may indirectly effect the health of juvenile salmonids that prey on them.

Dimethoate. Dimethoate is highly toxic to fish and to aquatic invertebrates. A summary of toxicity values for aquatic life published in the literature for dimethoate is found in the Provolt RA. Dimethoate is highly soluble and highly mobile in soil, the potential of leaching and runoff to water is high. Dimethoate can be rapidly broken down by most soil microorganisms with soil half-lives ranging generally from 4 to 16 days, but as high as 122 days, have been reported; a representative value would be 20 days (Extoxnet 2000).

Environmental factors may also influence organophosphate toxicity to aquatic species, altering effect estimates to fish. In general, acute toxicity of chlorpyrifos and azinphos-methyl were found to increase with temperature, pH, and body size of fish. Within the Applegate River and Williams Creek Watersheds, low summer stream flows, hot summer air temperatures, low-gradient valley bottoms, lack of riparian vegetation, and high channel width-to-depth ratios result in stream temperatures that can stress aquatic life and could exacerbate organophosphate toxicity.

The Provolt BA lists relevant assessment endpoints and effect concentrations of acephate, chlorpyrifos, diazinon and dimethoate and other relevant organophosphates to salmonid species.

Organosulfites. Propargite is an organosulfur miticide/acaricide that is highly toxic to fish, is moderately persistent (38-168 days), but is immobile in soils, and not very soluble in water. A summary of toxicity values for aquatic life published in the literature for propargite is found in the Provolt RA. Having a high affinity for soil and sediment, propargite has the potential to move off the site of application during rainfall/irrigation by erosion/runoff on soil particles and by drift. Given the moderate to slow degradation rates for metabolism and photolysis, and the high Koc[9] values, propargite will probably partition to sediments and organic material if transported to surface waters (EPA 2000b). No data is available on environmental influences to toxicity.

Propargite does not share a common mechanism of toxicity with other pesticides (EPA 2000b), and may not elicit a cumulative risk with other pesticides from a purely mechanistic perspective. However, it is a contributor to the overall pesticide burden that an aquatic organism may experience and could, in combination with other stressors, pose a significant risk in small amounts.

Pyrethroids. Pyrethroids, including esfenvalerate and permethrin, are highly toxic to aquatic invertebrates and fish. The pyrethroid group share similar mechanisms of toxicity, resembling that of Dichlorodiphenyltrichloroethane (known more commonly as 'DDT'), targeting the central and peripheral nervous system, resulting in greatly altered ionic currents and disrupted nerve function through membrane depolarization (Eisler 1992). Disruption to the neuromuscular system, through neurotoxic modes of action, can affect foraging behavior, predator avoidance, swimming performance and other coordinated muscular movement. Environmental factors may also influence pyrethroid toxicity to aquatic species. Toxicity has been known to increase with higher water temperatures, suspended sediments, and acidity.

Esfenvalerate. Esfenvalerate is very highly toxic to aquatic species. A summary of toxicity values for aquatic life published in the literature for esfenvalerate is found in the Provolt RA. The persistence of esfenvalerate varies on environmental conditions with half-lives in direct sunlight, soil, and water being 7.5 days, up to 90 days, and 10 to 220 days, respectively. Sublethal effects of inhibited olfactory response to a female reproductive pheromone were found at concentrations of less than 0.004 mu g/L or 4 parts per trillion in Atlantic Salmon (Moore and Waring 2001). The same study found exposure of milt and eggs to a concentration of 0.1 mu g/L reduced egg fertilization. These sublethal effects occur at low concentrations that would precede any effects realized at the individual level but could potentially have consequences at the population level.

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[9] Koc is a sorption coefficient that is often used to compare the relative mobility of different pesiticides. The higher the Koc value the more strongly the pesiticide is sorbed, and therefore the less mobile it is.

Permethrin. Permethrin is highly toxic to fish and especially aquatic macroinvertebrates. A summary of toxicity values for aquatic life published in the literature for permethrin is found in the Provolt RA. Permethrin's water solubility is low and exhibits a strong tendency to bind to soil particles. High amounts of suspended sediment may increase the bioavailability to aquatic organisms.

Nicotinoids. These insecticides include imidacloprid, a relatively new insecticide that acts on the central nervous system of insects, causing irreversible blockage of post-synaptic nicotingergic acetylcholine receptors. Imidacloprid is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. Movement of imidacloprid is restricted to the vascular system of the tree and kills insects when they feed. The potential for imidacloprid to enter air, soil, or water is negligible when using Imicide® capsules.

Herbicides. Herbicides can impair the essential biological requirements of salmon if they undermine the physical, chemical, or biological processes that collectively support a productive aquatic ecosystem (Preston 2002). The alteration of watershed characteristics by herbicides can include: Disruption of the growth of riparian deciduous vegetation, reduction of delivery of leaves and intermediate-sized wood, and alteration of hydrologic and sediment delivery processes (Spence *et al.* 1986). Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the toxic effects of herbicides. The application of herbicides can affect the productivity of the stream by altering the composition of benthic algal communities, the food source of macro-invertebrates. Benthic algae are important primary producers in aquatic habitats, and are thought to be the principal source of energy in many mid-sized streams (Minshall, 1978; Vannote *et al.* 1980; Murphy, 1998). Herbicides can directly kill algal populations at acute levels or indirectly promote algal production by increasing solar radiation reaching streams by disruption of riparian vegetative growth. The disruption of riparian vegetative growth carries with it other adverse consequences for salmonid habitat, such as loss of shade, bank destabilization, and sediment control. Therefore, herbicides can potentially impact the structure of aquatic communities at concentrations that fall below the threshold for direct impairment in salmonids. The integrity of the aquatic food chain is an essential biological requirement for salmonids, and the possibility that herbicide applications will alter the productivity and watershed characteristics of streams and rivers exist.

Herbicides can cause significant shifts in the composition of benthic algal communities at concentrations in the low parts per billion (Hoagland *et al.* 1996). Moreover, based on the data available, herbicides have a high potential to elicit significant effects on aquatic microorganisms at environmentally relevant concentrations (DeLorenzo *et al.* 2001). In many cases however, the acute sensitivities of algal species to herbicides are not known. In addition, Hoagland *et al.* (1996) identify key uncertainties in the following areas: (1) The importance of environmental modifying factors such as light, temperature, pH, and nutrients; (2) interactive effects of herbicides where they occur as mixtures; (3) indirect community-level effects; (4) specific modes of action; (5) mechanisms of community and species recovery; and (6) mechanisms of tolerance by some taxa to some chemicals. Herbicide applications have the potential to impair

autochthonous production and, by extension, undermine the trophic support for stream ecosystems.

Glyphosate. Glyphosate, an amino acid derivative, is a broad-spectrum, non-selective systemic herbicide. It is absorbed by leaves, moves rapidly through the plant, and acts to prevent production of an essential amino acid that inhibits plant growth. Glyphosate is slightly toxic to fish, and practically non-toxic to aquatic invertebrate animals (USDA 2001). However, the presence of inert ingredients may exacerbate its toxicity. A summary of toxicity values for aquatic life published in the literature for glyphosate is found in the Provolt RA. Glyphosate is strongly adsorbed to most soils, and dissolves easily in water. Glyphosate remains unchanged in the soil for varying lengths of time, depending on soil texture and organic matter content. The half-life of glyphosate can range from 3 to 130 days (USDA 2001). Soil microorganisms eventually break down glyphosate and the potential for leaching is low due to the soil adsorption. Although glyphosate has a low propensity for leaching, it can enter waterbodies by other means, such as overspray, drift, or erosion of contaminated soil (EPA 1993). Once in water, glyphosate is strongly adsorbed to any suspended organic or mineral matter and is then broken down primarily by microbes.

The toxicity of glyphosate to aquatic species increases with increasing temperature and pH (SERA 2003a). In the aquatic environment with freshwater fish, toxicity appears to increase with increasing temperature and pH. As reported in the Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates (USFWS 1980), glyphosate was twice as toxic to rainbow trout at 17°Celsius than at 7°Celsius. With bluegills, toxicity was twice as toxic at 27°Celsius compared to 17c. Toxicity was also two to four times greater to bluegills and rainbow trout at a pH level of 7.5 to 9.5 than at pH 6.5 (PH of 7.0 is considered 'neutral water'). However, the EPA (1993) states that glyphosate is stable at pH 3, 6, 9 at 5 and 35 environmental concentration.

Glyphosate acid and its salts are classified as 'moderately toxic' compounds by the EPA. Technical glyphosate acid (parent compound) is 'practically nontoxic' to fish and may be 'slightly toxic' to aquatic invertebrates. The 96-hour LC50 is 86-140 milligrams per litre (mg/L) in rainbow trout and 120 mg/L in bluegill sunfish. The 48-hour LC50 for glyphosate in daphnia (water flea), an important food source for freshwater fish, is 780 mg/L. The results of a rainbow trout yolk-sac 96-hour LC50 static bioassay yielded results at the 3.4 mg/L level.[10]

There is a very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms.[11] In one study of bioaccumulation and persistence, glyphosate was applied to two hardwood communities in Oregon coastal forest and none of the 10 coho salmon fingerlings analyzed had detectable levels of the herbicide or its metabolite aminomethyl-

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[10] USGS acute toxicity website: http://www.cerc.usgs.gov/data/acute/acute.html

[11] Extoxnet website: http://extoxnet.orst.edu/

phosphonic acid, although levels were detectable in streamwater for three days and in sediment throughout the 55-day monitoring period.[12]

Dicamba. Dicamba is a member of the benzoic acid chemical family. Benzoic acid herbicides are similar in mode of action and structure to the phenoxy herbicides, such as 2,4-D. Like phenoxy herbicides, dicamba mimics a plant growth hormone, affecting cell division (Cox 1994). Study results in aquatic organism toxicity have yielded varying results. Dicamba is slightly toxic to fish and may be toxic to aquatic macroinvertebrates (SERA 1999). A summary of toxicity values for aquatic life published in the literature for dicamba is found in the Provolt RA. Dicamba is moderately persistent in soil and highly mobile in soil. Half-lives vary significantly, from one to six weeks (EPA 1983), with the typical half-life being four weeks (Weed Sci Soc Amer 1983). When applying dicamba, exposure to non-target species may be difficult to control due to its high volatility (SERA 1999).

Dicamba is categorized by the EPA as 'slightly toxic' to fish, and 'practically non-toxic' to aquatic organisms. The LC50 (96-hour) for technical dicamba is 135 mg/L in rainbow trout (*O. mykiss*) and bluegill sunfish (*Lepomis microchirus*). The LC50 (48-hour) for dicamba is 35 mg/L in rainbow trout (USDA 2001). It is important to note that although dicamba is 'slightly toxic' to fish, there are variations in study results with reference to salmonids. One study found that there were no effects on yearling coho salmon at concentrations up to 100 parts per million (ppm). However, yearling coho were killed by much smaller doses (0.25 ppm) during a seawater challenge test that simulated their migration from river to ocean (Cox 1994). Little is known about sublethal effects on fish.

Dicamba does not bind to soil particles. Microbes appear to be the primary source of chemical breakdown the soil. In sterilized soil, over 90% of applied dicamba was recovered after four weeks, suggesting that microbes were responsible for the decomposition.[13] Sunlight does not appear to play a major role in breakdown, as with many other herbicides. Volatilization (vaporization) of dicamba from soil surfaces may not be an important process, although some volatilization can occur from plant surfaces. The principal soil metabolite appears to be 3,6-dichlorosalicylic acid.

Picloram. Picloram is a pyridine carboxylic acid herbicide that acts as a plant growth regulator (SERA 2003c). It is absorbed by the plant roots, leaves and barks. It moves both up and down within the plant, and accumulates in new growth, interfering with the plant's ability to make proteins and nucleic acids. It is moderately toxic to fish and slightly toxic to aquatic invertebrates. Picloram is highly soluble in water, resistant to biotic and abiotic degradation processes, and degrades very slowly with half-lives ranging from 167 to 513 days (EPA 1995). Its major route of dissipation appears to be leaching. Given its high persistence, it appears

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[12] Toxnet website: http://toxnet.nlm.nih.gov

[13] Toxnet website: http://toxnet.nlm.nih.gov

unlikely that picloram will degrade once it reaches groundwater, even over a period of several years (EPA 1995). While not as toxic as other the chemicals examined in this consultation, the environmental fate characteristics of picloram may ensure introduction into coho habitat and subsequent exposure.

Fungicides. Chlorothalonil is a member of the polychlorinated benzene carbonitrile fungicide class of pesticides. This chemical is toxicologically dissimilar to existing chemical substances currently used at Provolt and is not expected to share a common mechanism of activity. The results of the 96-hour acute toxicity studies indicate that chlorothalonil is very highly toxic to fish and aquatic macroinvertebrates (EPA 1999). A summary of toxicity values for aquatic life published in the literature for chlorothalonil is found in the Provolt RA. There is a lack of data on the effects on early life stages, sublethal behavioral effects or environmental influences on toxicity.

Chlorothalonil is almost non-soluble in water, has not generally been considered a highly mobile pesticide, and is more likely to be found in runoff from treated areas. The persistence of chlorothalonil varies with environmental conditions and is resistant to hydrolysis, photolysis, and volatilization, and only moderately susceptible to degradation in soil under aerobic conditions (EPA 1999). Chlorothalonil can contaminate surface water via spray drift or through runoff and erosion. Chlorothalonil in the soil under aerobic conditions degrades to SDS-3701. SDS-3701 appears to be more persistent, mobile, and available for runoff for longer periods than chlorothalonil. However, studies have shown that SDS-3701 is significantly less toxic than parent chlorothalonil (EPA 1999).

Adjuvants. Numerous adjuvants, solvents, and other 'inert' ingredients are also contained in pesticide formulations, many of which are toxic to aquatic species (Stark and Walthall, 2003), and consequently are also applied in the watersheds. Frequently used adjuvants include surfactants such as nonylphenol polyethoxylates, alkylbenzene sulfonate, polyethoxylated alkyl amines, and others. Toxic solvents include kerosene, naphthalene, cyclohexanone, ethylbenzene, xylene, a variety of oils, and other pesticides. Inert ingredients are generally inclusive of adjuvants and solvents, but may include other additives as well. The proprietary nature of many pesticide formulations can make analyzing pesticide formulation toxicity mechanisms difficult due to undisclosed ingredients. In addition, in some cases, the pesticide active ingredient may be less toxic to aquatic species than the 'inert' ingredients.

Adjuvants include the following:

1. Surfactants (surface-active ingredients). These are substances that improve the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids. Surfactants include emulsifying agents, crop oils, concentrates, and stickers.
2. Emulsifying Agents. An emulsion is a mixture of two incompletely mixed liquids, one which is dispersed in the other. Emulsifying agents work to promote the suspension of one liquid in the other. In herbicides, there are two types of emulsions: "Oil-in-water" emulsion, in which the spray mixture is similar to water; and "water-in-oil" emulsion, a

rather viscous spray, also called "invert" emulsions. The "oil-in-water" emulsions are widely used in the formulation of herbicides to aid in getting an oil-soluble herbicide dispersed in a water mixture so that the active ingredient may be applied as a water spray. Inert emulsions are used to aid in drift control, to improve resistance of the herbicide treatment to the effects of weather (rain), to improve accuracy of delivery of the herbicide, and to enhance herbicide activity.

3. Wetting Agents (spreaders). Spreaders are added to decrease surface tension in a mixture and cause a larger portion of each spray droplet to come in contact with surface of the vegetation. The goal is to increase coverage and effectiveness, although it may also alter herbicide selectivity. There are four spreader types: (1) Anionic, which has an electrical charge in water; (2) cationic, which has an electrical charge in water; (3) nonionic, which does not have an overall electrical charge; and (4) amphoteric, which has positive or negative charges, depending on the pH of the solution.
4. Drift Control Agents. Drift of herbicide sprays can be a problem in some environments. One way to reduce herbicide drift is to increase the droplet size of the spray. Adjuvants that are used to control drift do so, in part, by reducing the number of fine spray droplets. Thickeners may be used as drift control agents.
5. Crop Oil Concentrates. These are products that contain 80-85% petroleum or vegetable oil and 14-20% surfactant and emulsifiers. An "emulsifiable oil," on the other hand, is a product that contains 98% oil and 1-2% emulsifiers. This group is also called "nonphytotoxic oils" and "phytobland oils."
6. Stickers. These are adjuvants that cause herbicide to stick to foliage and prevent runoff from target vegetation. The desired result is increased effectiveness.
7. Compatibility Agents. These are adjuvants that aid in the suspension of herbicides when they are combined with other pesticides or fertilizers. Used primarily when the carrier solution is a liquid fertilizer.
8. Acidifiers and Buffers. Acidifiers are acids that neutralize alkaline solutions and lower pH when added to herbicide, while buffers can change the pH to a certain level and maintain it, even if the alkalinity changes.
9. Antifoaming Agents and Spray Colorants. Defoaming agents and dyes.

Specific Inert Ingredients Known to be Present in Products Proposed for Use.

Cyclohexanone. Cyclohexanone is present in the Digon® 400 formulation of dimethoate.

Ethylbenzene. Present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin. This inert ingredient is most commonly found in vapor form since it moves easily into the air from water and soil. In the air, ethylbenzene is broken down by sunlight in approximately three days. In surface water, it breaks down by reacting with other pesticides. In soils, ethylbenzene is broken down by bacteria.

Light aromatic solvent naphtha. Present in the Pounce® 3.2 EC formulation of permethrin. Light aromatic solvent naphtha is slightly toxic to terrestrial species, as illustrated by the data summarized in the RA.

Petroleum distillates. Present in the Digon® 400 formulation of dimethoate.

Xylene. Present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin. The inert ingredient xylene very quickly evaporates into the air from surface water and soil where it may remain for several days until it is broken down by sunlight. Because xylene is applied as a liquid, it does have the potential to infiltrate into the soil. Most xylene insurance water evaporates into the air in less than a day. Xylene is more persistent in groundwater where evaporation is impaired.

In some cases, the pesticide active ingredient may be less toxic to aquatic species than the 'inert' ingredients. The herbicide glyphosate provides a classic example. The LC50 values for rainbow trout range for technical grade glyphosate range from 86 mg/L to 140 mg/L (EPA, 1993). However, LC50 values for rainbow trout to glyposate formulations range from 8.2 mg/L to >1000 mg/L (EPA 1993), depending on the adjuvants and surfactants added.

Herbicide mobility in soil can be increased by the use of surfactants, but effects to mobility are unlikely due to the relatively low concentration of surfactants in the soil/water matrix at Forest Service application rates (Bakke 2002) which are comparable to BLM application rates. In general, it appears that aquatic species are more susceptible to adverse effects from surfactants than terrestrial species. At least some of the aquatic sensitivity to surfactants is due to irritation of gill membranes and alteration of their permeability and molecular exchange properties.

Impurities may also pose risks for aquatic species. Hexachlorobenzene, classified as a human carcinogen, is an impurity in picloram (SERA 2003). Hexaclorobenzene is ubiquitous and persistent in the environment. Under typical application scenarios, it volatilizes from the soil or vegetation surface, but can bioconcentrate in fish if it reaches aquatic habitats. Hexachlorobenzene can contaminate water by runoff or volatilization and deposition in rainwater. Because hexachlorobenzene binds tightly to soil, it is not likely to percolate through soil to contaminate groundwater.

Effects of IPM Implementation

Chemical use within the proposed IPM program is reasonably likely to result in sublethal adverse effects to ESA-listed salmonids within the action area. Within the past several years, the following studies documented that significant sublethal effects to salmonids can result from exposure to pesticides and other toxic pesticides. Sandahl *et al.* (2004) documented that chlorpyrifos (an organophosphate insecticide) and copper (a metal) both caused loss of olfactory sensory function in juvenile coho salmon at environmentally relevant concentrations. A 20% reduction in olfactory sensory function occurred at 4.4 µg/l for copper and 0.72 µg/l for chlorpyrifos. In addition, Sandahl *et al.* (2004) demonstrated that a concentration of 0.2 µg/l of

the insecticide esfenvalerate evoked distinct and irregular bursts of postsynaptic activity in the olfactory bulb of juvenile coho salmon. These effects could interfere with olfactory mediated behaviors that are important for the survival and migration of salmonids.

Scholz *et al.* (2000) documented sublethal behavioral effects in Chinook salmon from the insecticide diazinon at concentrations as low as 1.0 µg/l. Since the behavioral effects observed by Scholz *et al.* included inhibition of predator avoidance, the 'sublethal' exposure could ultimately result in death.

Accurate assessment and understanding of sublethal effect thresholds are further complicated by allostatic loading, as described by McEwen and Wingfield (2003). Briefly, allostatic loading results when organisms are exposed to multiple stressors during their life cycle that reduce the chance of reproductive stress. Further, in a study of environmental contaminants on behavior, Weis *et al.* (2001) stated: "It is assumed that effects at the molecular and cellular levels precede detectable effects at the individual organism level, which precede effects at the population and community level." As evidence, Weis (2001) found that neurotoxic effects at the biochemical level altered the predator-prey behavior of the mummichog, (*Fundulus heteroclitus*) which then had consequences that were in clear connection on the population and community structure such as reduced growth and condition. Pollution exposure, whether it be from elevated pesticide concentrations or more conventional impacts such as anoxia or high temperature, may also lead to reduced growth rates and infection for juvenile salmonids but even these responses are preceded in time by effects at the molecular level and can have connections to the population and community level.

Most adverse effects from the chemical portion of the IPM plan are likely to be sublethal, which can be further divided into narcosis and rheotropism. Sublethal or nonlethal endpoints do not require that mortality be absent; rather, they indicate that death is not the primary toxic endpoint being examined. Rand (1995) states that the most common sublethal endpoints in aquatic organisms are behavioral (*e.g.*, swimming, feeding, attraction-avoidance, and predator-prey interactions), physiological (*e.g.*, growth, reproduction, and development), biochemical (*e.g.*, blood enzyme and ion levels), and histological changes (*e.g.*, degenerative necrosis of the liver, kidneys, and gill lamellae; Lorz *et al.* 1979). Some sublethal effects may indirectly result in mortality. Changes in certain behaviors, such as swimming or olfactory responses, may diminish the ability of the salmonids to find food or escape from predators and may ultimately result in death. Some sublethal effects may have little or no long-term consequences to the fish because they are rapidly reversible or diminish and cease with time. Individual fish may exhibit different responses to the same concentration of toxicant. The individual condition of the fish can significantly influence the outcome of the toxicant exposure. Fish with greater energy stores will be better able to survive a temporary decline in foraging ability, or have sufficient metabolic stores to swim to areas with better environmental conditions. Fish that are already stressed are more susceptible to the deleterious effects of contaminants, and may succumb to toxicant levels that are considered sublethal to a healthy fish.

Narcosis and rheotropism, discussed further below, are two types of sublethal effects that compromise salmonids ability to migrate, feed, and seek refuge from predators. In some instances, sublethal effects such as reduced predator avoidance, may indirectly result in injury or mortality to ESA-listed salmonids, through increased predation.

Sublethal Effect - Narcosis. When exposed to elevated concentrations of polar and non-polar organic pesticides, fish can become narcotized. Narcosis is a generalized, non-selective toxicity response that is the result of a general disruption of cell membrane function. The process of narcosis is poorly understood, but is thought to involve either a 'critical volume' change in cellular membranes due to the toxicant dissolving into the lipid membrane and altering its function, or by the 'protein binding' process in which hydrophobic portions of receptor proteins in the lipid membrane are bound by the toxicant molecules, thus changing the receptor protein's function (Rand 1995). A fish with narcosis is more susceptible to predation as a result of a loss of equilibrium, a reduction in swimming ability or a lack of predator avoidance behavior. Furthermore, a fish with narcosis also has difficulty maintaining its position in the water column, and can be carried by water currents into areas of sub-optimal water quality.

Sublethal Effect - Rheotropism. Rheotropism refers to fish behavior in a current of water, either directly as a response to water flowing over the body surface or indirectly as a response to the visual, tactile or inertial stimuli resulting from the displacement of fish in space (Dodson and Mayfield 1979). Several studies involving the herbicide 2, 4-D (which is not proposed for use in the IPM) provide example's of rheotropism. Folmar (1976) used rainbow trout fry in an investigation to determine whether fish avoided water contaminated by 2, 4 D. At concentrations of 1.0 or 10.0 mg/L of 2,4-D, there was significant avoidance of the chemical. Similarly, Dodson and Mayfield (1979) assessed the effect of 2,4-D on the reotaxic response (the tendency to swim upstream to compensate for flowing water) of rainbow trout. The report stated that, at 'realistic concentrations' of 2,4-D in water, there would be a tendency for fish to be moved downstream because of a reduced reotaxic response.

Chemical Interactions and Mixture Toxicity. Rand (1995) states that in 'assessing chemically induced effects (responses), it is important to consider that in the natural aquatic environment organisms may be exposed not to a single chemical but rather to a myriad or mixture of different substances at the same or nearly the same time. Exposures to mixtures may result in toxicological interactions.' A toxicological interaction is one in which exposure to two or more chemical residues results in a biological response quantitatively or qualitatively different from that expected from the action of each chemical alone. Exposure to two or more chemicals simultaneously may produce a response that is simply additive of the individual responses or one that is greater (synergistic) or less (antagonistic) than expected from the addition of their individual responses. Application of pesticides within the IPM is likely to contribute to elevated toxicological responses caused by other sources of chemical pesticides within the action area.

The temporal and spatial variability of the composition of mixtures, along with local water quality parameters, makes understanding and predicting relative effects a complex and challenging task. Furthermore, sublethal effects, which by nature are less apparent than lethality,

have rarely been studied in conjunction with exposure to chemical mixtures (Kraak *et al.* 1994 as cited in Forget *et al.,* 1999).

Given the proposed five-year implementation of the IPM plan and the number of herbicides and pesticides and application events, many discreet variables will influence relative effects (*i.e.*, exposure) to ESA-listed salmonids. Variables range from weather (wind/rain/temperature/humidity), the fate characteristics of the pesticide, herbicide or fertilizers, implementation of CPs, the particular application area's topography and composition of the nearest waterway buffer, the lifestage of the salmonid, relative water quality, and background concentrations from non-BLM applications. The pathways of potential exposure to ESA-listed salmonids and their prey base can be from waterborne delivery, either through overland flow or subsurface flow, or through airborne drift soon after application.

To explore the likelihood/magnitude of exposure from individual applications, the BLM addressed predicted effects from the standpoint of the lowest observable effects level from individual pesticides, herbicides and fertilizers. The BLM incorporated several models to conduct this analysis. Drift was modeled through the Agricultural Drift (AgDRIFT) model and runoff was predicted using the GLEAMS and MOC models. The use of models to predict environmental concentrations resulting from pesticide, herbicide and fertilizer use is complicated by the wide range variables described above. To simplify the task, the BLM incorporated a limited number of application scenarios based on anticipated operations and circumstances. While the scenarios chosen in the RA are intended for use in predicting expected conditions, a conservative bias or worst possible case scenario was incorporated when assumptions were required. General model assumptions are discussed below, and discussed in more detail further within this analysis.

The GLEAMS model was used to predict runoff of chemicals and water as they might be measured at the edge of each orchard unit. However, the Provolt units generally have significant areas of untreated field edges and well-vegetated buffers between treated acreage and receiving streams. These untreated intervening areas, collectively termed 'buffer zones,' are expected to have a significant effect in reducing the amount of chemicals that actually reach streamwater. To account for the attenuating effect of buffer zones, the MOC model was set up to represent steady saturated shallow subsurface flow across a minimum 30-foot buffer zone. The fate and transport modeling assumptions used in the RA correspond to the pesticide application details of (Maximum Production IPM), and that the proposed action (Alternative B, IPM with Environmental Protection Emphasis) actually contains additional limitations on certain aspects of chemical pesticide and fertilizer use to provide added protection to human health and the environment.

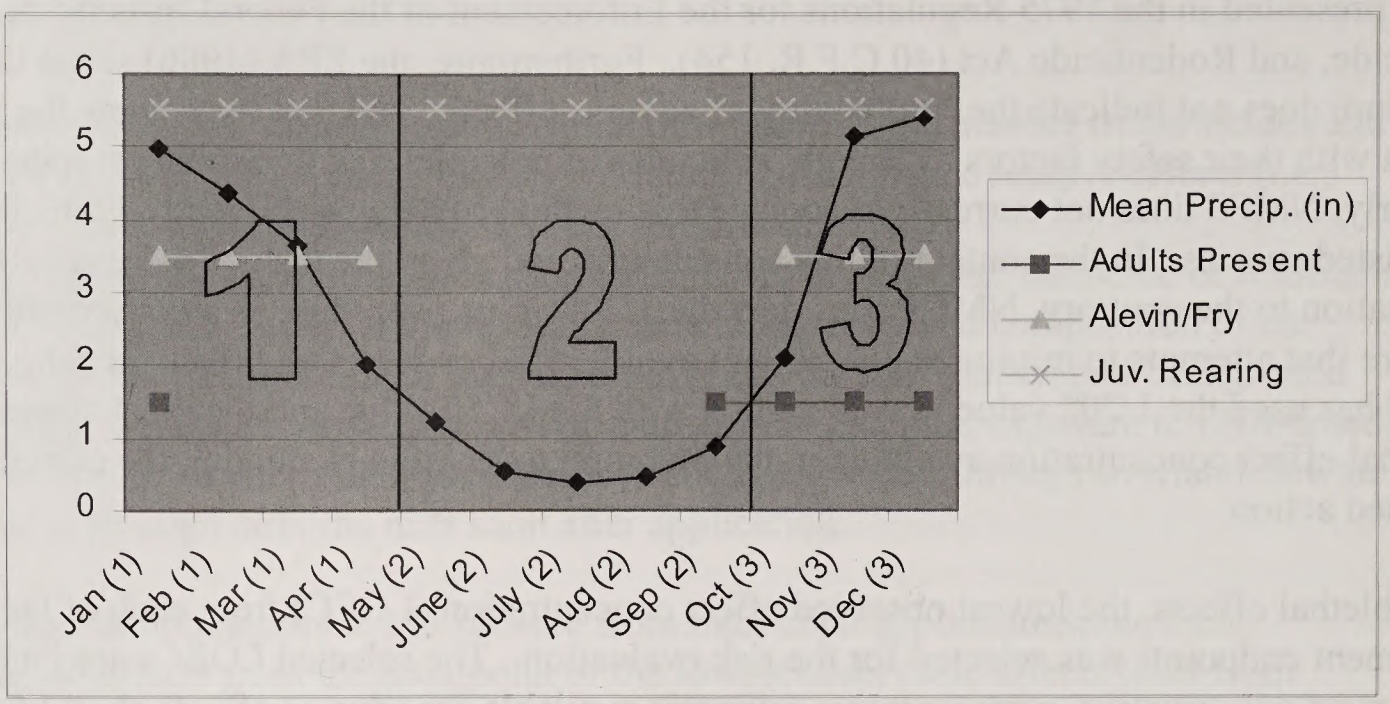
The proposed action was developed based on the results of the RA. These limitations, such as the use of wider buffers for certain pesticide application methods, provide additional protection against the possibility of adverse effects to listed fish species.
The BLM used the Quotient Method (EPA 1986) in their BA to evaluate risk to aquatic organisms and threatened salmonids. However, the method is based on lethal response and

assumes that the dose/response curve resembles a typical curve produced from a toxicological model presented in the 1975 Regulations for the Enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act (40 C.F.R. 154). Furthermore, the EPA (1986) states that the procedure does not indicate the 'probability of adverse effects,' and that they 'view the risk of criteria with their safety factors as 'rough' estimates of potential risk to non-target species.' Similarly, NMFS does not currently recognize this method as being sufficiently protective of ESA-listed species. In the context of this consultation and given the lack of more specific information to the contrary, NMFS considers the $1/20^{th}$ value procedure as a conservation measure that attempts to minimize, though not avoid, lethal or sublethal effects in coho salmon. NMFS has used the $1/20^{th}$ value in conjunction with the LC50 value and the most conservative sublethal effect concentration available in the literature to assist in evaluating the effects of the proposed action.

For sublethal effects, the lowest observed effect concentration (LOEC) from each of the three assessment endpoints was selected for the risk evaluation. The selected LOECs are intended to be the most conservative, representative estimates available for adverse effects at all life-stages related to survival, migration, or reproduction. The estimated pesticide concentration over the sublethal effect level was defined as an effects ratio. Risks to survival, migratory, and reproductive endpoints were determined to be low if the effects ratio was 0.1 or below, moderate if 0.1 to 1.0, and high if 1.0 or greater.

While the modeling assumptions are conservative, it is important to note model results just express output concentrations from applications that do not account for potential multiple exposures to listed fish and to their supporting ecosystems. Multiple exposures to single or combined pesticides, herbicides and fertilizers from the proposed multi-year, multi-location BLM applications may be delivered to non-target aquatic habitats, particularly during fall and spring runoff events. Potential non-target runoff areas support each of the ESA-listed salmonid life history stages. Repeated exposure to the same pesticides, herbicides or fertilizers or from exposure to mixtures are likely to result in adverse effects to ESA-listed salmonids. Moreover, the risk of adverse effects increase when BLM-produced pesticide herbicide or fertilizer runoff is added to waterways that are already contaminated. The BA indicates that receiving waterways with listed fish have elevated temperatures during certain periods of the year. Studies have demonstrated that elevated temperatures may increase the susceptibility of listed fish or their prey base to small concentrations of pesticides, herbicides, or fertilizers (Folmar *et al.* 1979; Woodward 1976; Kumaraguru and Beamish 1986).

Figure 2. Timing of Listed Species by Lifestage and Annual Precipitation - Provolt



For the purpose of this analysis, the calendar year has been divided into three general zones of exposure risk to ESA-listed salmonids from the proposed action, as depicted in Figure 2. Through these three zones, the precipitation and number and type of pesticide, herbicide and fertilizer applications determine the relative risk to ESA-listed salmonids.

Corresponding to Figure 2, the precipitation and lifestages and relative risk of exposure has been summarized in Table 7.

Table 7. Precipitation, Lifestage, and Application/Delivery Risk to SONC Coho Salmon

Zone One (January through April)	**Ranges from 5 - 2 inches per month. 48% of annual precipitation occurs in this period.**
Coho Lifestage(s)	Adults (generally January only), incubating eggs (alevin) and newly-emerged fry, as well as juveniles up to 1.5 years old.
Applications and delivery risk:	Most BLM applications would occur during the latter stages (March and April) of zone one as the growing season arrives.
Zone Two (May through September)	**Precipitation ranges from just over 1 inch to less than half an inch per month. 11% of the annual precipitation occurs in this period.**
Coho Lifestage(s)	Alevin/fry in May, June, and rearing juveniles throughout. Adults are present in the latter stages of zone.
Applications and delivery risk:	Zone two generally encompasses the most risk from insect pest as well as the vegetation growing season, thus the majority of BLM applications are proposed to occur within zone two. Precipitation is generally readily predictable in this season. Since most BLM compound applications will occur within this time-frame, the greatest potential for accumulation of compounds on orchard grounds exist.

Zone Three (October through December):	**Precipitation rises dramatically from 2 inches to over 5 per month. 41% of the annual precipitation occurs in this period.**
Coho Lifestage(s)	All lifestages are present during this zone.
Applications and delivery risk:	Most BLM applications would occur during the beginning of this zone, though there may be several applications (over the five-year term) in each month. The increase in precipitation during this zone could deliver compounds that have accumulated (but not yet delivered to aquatic systems) on orchard grounds from zone one, and particularly zone two through runoff and subsurface flow pathways.

Factors of Uncertainty. Predicting exposure levels or effects from specific exposure levels is difficult because of the uncertainty inherent in the tools used to conduct effects analyses. Sources of analytical tool uncertainty are lack of information regarding laboratory to field extrapolation, mixture effects, toxicity and behavior of degradation/metabolic products, use of physiologically/ecologically relevant endpoints based on the pesticide mechanism of action, and reliance on short-term toxicity tests. All of these sources of uncertainty fall into one or more of three basic categories: (1) Parameter uncertainty (measurement, sampling, and systematic errors); (2) modeling uncertainty (simplification of real world processes, model misuse, use of inappropriate surrogates); and (3) scenario uncertainty (descriptive, aggregation, and professional judgement errors).

Examples of sources of uncertainty associated with the proposed project are: (1) The fate of herbicides in streams; (2) modeling uncertainty; (3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; (4) the toxicity of pesticide mixtures; and (5) the mitigating or exacerbating effects of local environmental conditions. Where appropriate, these and other uncertainties will be identified, and where uncertainties cannot be resolved using the best available scientific literature, the benefit of the doubt will be given to the threatened or endangered species in question.

Vectors of Exposure.

Waterborne Delivery. The BA indicated that there are three primary scenarios of pesticides reaching the stream channel due to the proposed action:

1. Drift from chemical spray. This period of concern lasts for hours, usually until the chemical has been allowed to dry on foliar surfaces.
2. Runoff from the fields to which spray is applied. This period also lasts on the scale of several hours, during which time the rain flowing over foliar and soil surfaces collects the most available chemical residues (either dissolved or associated with fine particulate).
3. Potential spills in and near stream channels. Spills are instantaneous loads of pesticide delivery directly into the water.

These scenarios have the potential to transport chemicals to adjacent drainages and waterways which ESA-listed salmonids occupy for migration, rearing, and spawning. Large amounts of precipitation which expands the ephemeral stream system can result in flowing water coming into contact with pesticide deposits (Norris 1980 as cited in Dent and Robben 2000). The adsorption potential, stability, solubility, and toxicity of a chemical determines the extent to which it will migrate and adversely effect surface waters and groundwater (Spence *et al.* 1996).

Chemical Drift. Drift occurring immediately after application is one way that exposure to non-target species may occur outside the application area. In evaluating drift effects to non-target species, The BLM modeled off-target pesticide drift from ground vehicle and hand methods of pesticide applications using AgDRIFT, a cooperative model developed by the EPA Office of Research, the U.S.D.A. Agricultural Research Service, the Forest Service, and the Spray Drift Task Force.

No aerial applications of pesticide would be conducted at Provolt, though ground vehicle and hand methods of pesticide applications could result in spray drift and volatilized chemicals. Data from field studies were used to characterize drift from applications using high-pressure hydraulic sprayers, hand-held wands, and backpack sprayers. For all applications, the highest of the deposition values predicted for all potentially treated areas was used as the input to the quantitative risk calculations. The AgDRIFT model was used to estimate off-target drift deposition from ground boom applications of the herbicides dicamba and glyphosate.

Drift is dependent on gravity, air movement, and droplet size.[14] Smaller droplets stay aloft longer and the longer a droplet is suspended the greater the potential for it to be translocated by air currents. A droplet size of 100 microns (mist) takes 11 seconds to fall 10 feet in still air. The same size droplet would travel 13.4 feet in a 1 mph wind while dropping that same 10 feet, and 77 feet at 5 mph. Application pressure, nozzle size, nozzle type, spray angle, and spray volume are all factors in determining droplet size. Droplet sizes increase with decreasing pressure and larger nozzle sizes. An indicated droplet size (*i.e.* 300 microns) actually represents a median diameter of all droplets. Actual droplet sizes will range from considerably smaller as well as larger than the indicated droplet size. During temperature inversions little vertical air mixing occurs and drift can translocate contaminates several miles. In addition, low relative humidity and/or high temperature conditions will increase evaporation and the potential for drift. Proposed buffers, application criteria, and concurrent drift monitoring reduce this risk. Application during calm conditions would reduce spray drift.

Predicting environmental concentrations resulting from pesticide and fertilizer use at Provolt is complicated by the wide range of chemical, environmental, and operational assumptions. The modelers dealt with this uncertainty by choosing a limited number of scenarios based on anticipated operations and circumstances.

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[14] NebGuide website at http://www.ianr.unl.edu/pubs/pesticides/g1001.htm

For all applications, the highest of the deposition values predicted for all potentially treated areas was used as the input to the quantitative risk calculations. No drift beyond buffer areas is expected from other ground application methods, based on the results of field studies summarized in the RA report.

Table 8 shows a comparison of the exposure profile data (estimated water concentrations from spray drift) specific to Applegate River and Williams Creek, to stressor-response profile data (referenced LOECs) taken from attachment C of the BA to estimate the risk of adverse effects. The estimated surface water concentrations are extremely low, several orders of magnitude below levels of demonstrated sublethal effects. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs (Sec 9.1 in Provolt RA).

Table 8. RA-Modeled Stream Concentrations of Pesticides Under the Proposed Action Resulting from Application Drift, and Salmonid Effect Concentrations Selected by NMFS for Effects Evaluation

	Williams Creek		Applegate River		Effect Concentration		
Pesticide tractor-pulled rig with boom	**Typ**	**Max**	**Typ**	**Max**	**LOEC (mg/L)**	**Endpoint of Effect**	**REF**
Dicamba	6.73E-008	1.73E-008	5.99E-007	1.54E-007	1.8	mortality	Mayer and Ellersieck 1986
Glyphosate	6.73E-008	3.47E-007	5.99E-008	3.09E-007	0.046 (NOEC)	migration and growth	Morgan and Kiceniuk 1992

* No drift-to-surface water is predicted for other pesticides or other application methods.
** Numericsl values represent scientific notation.

From the perspective of viewing each application as a stand-alone event, the likelihood of direct adverse effects to SONC coho from drift are remote. The attenuating effects of vegetative buffer zones, the conservative nature of the analysis, the ecological protection measures in place (as described within the proposed action), and the individual modeled concentrations lead to this conclusion.

However, this judgement is academic in nature; it is solely from the perspective of an individual pesticide application, with no contributing factors such as a degraded baseline or additive and synergistic effects from other chemicals. Further, though the use of models represent the best available technology for predicting drift concentrations, the variables that can determine exposure risk (*i.e.*, weather) are likely to be highly variable over the five-year term of the proposed action. Given these factors, there is a reasonable likelihood that runoff concentrations will differ from those predicted and are reasonably likely to lead to adverse effects.

Runoff. The chemical and physical properties of the pesticide such as solubility in water and affinity to soil particles help determine the rate and method of transport. Chemicals that adsorb well to the soil will tend to immobilized and be broken down in place as opposed to highly soluble chemicals that could be washed away via soil surface or subsurface movement with irrigation or rainwater, and would more likely be a potential contaminant. The soils at Provolt are generally well-drained, with slow to rapid runoff and moderate permeability, and low amounts of organic material.

The BA characterizes the Provolt as more similar to a well-forested watershed than an agricultural area due to the seed trees and well-managed surface vegetation. True overland flow is very rare in well-managed forests and, although runoff does reach streams, it is mostly via subsurface shallow flow. During rainfall events, true surface runoff normally occurs first from streambanks, and then as the rain continues (and especially if it intensifies) from successively larger areas surrounding the streams.

Within the basin, pesticides are applied during irrigation season, and runoff of excess irrigation water from fields can transport them to surface water. Variations in temporal patterns of elevated pesticide concentrations can also be attributed to a seasonal rise in precipitation during the months of October through November. Significant rain events can increase erosion of soils with absorbed pesticides or flush of the more soluble pesticides and fertilizers. However, the climate at Provolt is characterized by fairly even precipitation with very few large, sudden rainfalls. This climate and the surface condition at the seed orchard are conducive to percolation rather than direct runoff of rainfall. Elevated concentrations of pesticides in the Applegate River and Williams Creek also have the potential to occur during irrigation season, which is generally from late May through September.

The BLM assessed runoff and leaching from the proposed action using the GLEAMS and the MOC models. GLEAMS will model the concentration of chemicals that will leave a target field, in this case an orchard block, that is transported by overland flow or that is adsorbed to soil particles transported in the flow by estimation of soil chemical concentrations, initial maximum runoff loadings, and long-term chemical loss in runoff, sediment, and soil below the root zone. The GLEAMS analysis included two scenarios: (1) Typical environmental characteristics and pesticide/fertilizer use; and (2) wet conditions and maximum pesticde/fertilizer use.

The model is not able to predict chemical concentrations reaching streams separated from the target fields by buffer areas. The Provolt units generally have untreated field edges and vegetated buffers between treated acreage and receiving streams. These untreated buffer zones are expected to reduce the amount of chemicals that actually reaches streamwater. Buffer zones between treated acreage and receiving streams at Provolt will typically be in the range of 30 to 100 feet or more. These untreated intervening areas are expected to have a very significant effect reduce the amount of chemicals that actually reach streamwater. To account for the attenuating affect of buffer zones, the MOC model developed by the USGS was used. This is a two-dimensional groundwater flow and chemical transport model, that computes changes in concentration over time, accounting for the processes of dispersion, adsorption, and degradation.

The uncertainty in the GLEAMS model can be attributed to the model's sensitivity to input parameters that were not directly measured and had to be estimated based on available literature. These parameters include pesticide decay rates, foliar washoff, Koc, and soil curve numbers. The decay rates and foliar washoff factors govern the quantity of the contaminant available for movement, whereas the sorption coefficients and the runoff curve numbers govern the actual movement of the contaminants. Uncertainty in these parameters causes the majority of model uncertainty and exacerbates the risk from exposure.

Table 9. RA-Modeled Stream Concentrations of Pesticides Under the Proposed Action Resulting from Runoff and Erosion, Effect Concentrations Selected by NMFS for Effects Evaluation

	Williams Creek		Applegate River		Effect Concentration		
Pesticide	**Typ**	**Max**	**Typ**	**Max**	**LOEC[1] (mg/L)**	**End-point**	**REF**
Hand-Held Ground Methods							
Chlorpyrifos	-0-	6.20E-009	-0-	2.41E-009	0.003	mortality	EPA 2000
Diazinon	-0-	3.25E-009	-0-	2.12E-010	0.001	predation	Scholz et al. 2000
Esfenvalerate	-0-	7.93E-010	-0-	1.22E-009	2.50E-005	predation	Little et al. 1993
-Ethylbenzene	-0-	-0-	-0-	8.72E-013	14	mortality	Mayer and Ellersieck 1986
- Xylene	-0-	-0-	-0-	-0-	0.1	rearing	Folmar 1976
Horticultural Oil	-0-	-0-	-0-	5.68E-010	100	mortality	Valent USA 1983
Permethrin	-0-	6.69E-010	-0-	1.16E-009	7.5E-004	predation	Kumaraguru et al. 1982
-Ethylbenzene	-0-	3.21E-011	-0-	2.09E-012	14	mortality	Mayer and Ellersieck 1986
-Light arom solv naphtha	-0-	3.98E-010	-0-	1.55E-010	0.32	mortality	EPA 2001
-Xylene	-0-	-0-	-0-	-0-	0.1	rearing	Folmar 1976
Propargite	-0-	4.46E-009	-0-	7.45E-009	0.008	mortality	Uniroyal 1998
Chlorothalonil	-0-	6.57E-009	-0-	3.45E-009	0.0049	mortality	Caux et al. 1996
Glyphosate	-0-	6.31E-010	-0-	2.46E-010	0.046 (NOEC)	migration and growth	Morgan and Kiceniuk 1992
Tractor-pulled spreader (general fertilizers)							
NO3	-0-	7.03E-005	-0-	3.32E-005	2	mortality	Rouse et al. 1999
NH4	-0-	6.11E-008	-0-	2.47E-009	0.0074	mortality	Knoph 1992

* Selected LOEC's are for various species of fish and might be less for aquatic macroinvertebrates (relevant to all tables)

** Numerical values represent scientific notation.

Table 9 shows a comparison of the exposure profile data (estimated water concentrations from runoff) specific to Applegate River and Williams Creek, to stressor-response profile data from attachment C of the BA to estimate the risk of adverse effects. The estimated surface water concentrations are extremely low, several orders of magnitude below the levels of concern. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs (Sec 9.1 in Provolt RA).

No risks were predicted from typical conditions of use. From the perspective of viewing each application as a stand-alone event, the likelihood of direct adverse effects to ESA-listed salmonids from runoff and erosion are small. The attenuating effects of vegetative buffer zones, the conservative nature of the analysis, conservation practices in place, and the individual modeled concentrations lead to this conclusion. However, as for spray drift, this judgement is academic in nature; it is solely from the perspective of an individual pesticide application, with no contributing factors such as a degraded baseline or additive and synergistic effects from other chemicals. Further, though the use of models represent the best available technology for predicting runoff concentrations, the variables that can determine exposure risk (*i.e.*, weather) are likely to be highly variable over the five-year term of the proposed action. Given these factors, there is a reasonable likelihood that concentrations will differ from those predicted and reasonably likely to lead to adverse effects.

Accidental Spills. The RA addressed spills through the Exposure Analysis Modeling System (EXAMS) model. EXAMS was developed at EPA's Center for Exposure Assessment Modeling at Athens, Georgia (Burns 2000). Model inputs of half-lives and adsorption coefficients determined the rate and extent of transport of organic chemicals throughout potential spill sites.

The likelihood of contaminant exposure from spills will be minimized through siting the mixing and loading zones in a designated chemical area away from water. These proposed CPs, combined with an adequate spill prevention plan should avoid the scenario of spill delivery of pesticides to surface waters.

Summary of Vectors of Exposure. After the application of chemicals in the field, there are two time periods in which exposure to non-target species may occur outside the application area. The first immediately follows the application event, and is the result of spray drifting or volatilizing from the field. This period of concern lasts on the order of hours, usually until the chemical has been allowed to dry on foliar surfaces. The second period occurs after the first rain event when chemical residues are carried off-site by surface water runoff. This period also lasts on the scale of several hours, during which time the rain flowing over foliar and soil surfaces collects the most available chemical residues (either dissolved or associated with fine particulates). Thus, the initial pulse of runoff entering the streams is most likely to carry the highest concentration of bioavailable pesticide residues.

Site conditions at the Provolt include multiple possible pathways of exposure to coho salmon. SONC coho salmon, often at multiple lifestages, are expected to be beside and downstream from Provolt throughout the year. In the event of a discharge into Williams Creek, the Applegate

River (and to a lesser extent the irrigation ditches), it is highly probable that coho will be in the vicinity of the exposure. As such, discharges from Provolt, via subsurface runoff, drift, or overland runoff, would have little time to become diluted or attenuate in concentrations. Irrigation ditches offer an additional risk for pesticide, herbicide or fertilizer introduction to surface waters. These irrigation ditches have grass species on each bank that offer reduced preventative function for the introduction of pesticide, herbicide and fertilizer from spills, drift[15] and overland surface water flows relative to more diverse vegetative communities. In the event of pesticide, herbicide and fertilizers reaching the irrigation ditches, return flows to the Applegate River and Williams Creek are likely to adversely effect coho or their prey base. While mixing and dilution will occur, the relatively stable hydraulic characteristics of the ditches may prevent significant dilution. Hydrologically complex waterways with meanders, pools, riffles, and eddies that accelerate mixing and dilution are more likely to disperse contaminants than simplified waterways with consistent channel velocities that allow contaminants to maintain a more consolidated profile (Lee 1995; Heard *et al.* 2001).

To address this increased risk, the BLM proposed that esfenvalerate would not be applied to trees in the two rows of orchard trees nearest and directly beside Williams Creek in units beside the creek: Units 1, 5, 7, 9, and 17; and the two rows of trees nearest the two irrigation ditches in units 5, 7, 12, 14, 15, and 16. These trees would then act as an additional shield against drift toward the surface water, as well as increase the buffer against overland runoff containing pesticide residues by as much as 200% in some areas.

Given Provolt's location within the floodplain of Williams Creek and the Applegate River, groundwater levels are likely to be very dynamic, particularly during spring (zone one) and fall (zone three). As such, delivery from subsurface flow pathways may be more efficient as well.

Given the likelihood of salmonid presence year-round in receiving waterways, in the event of a discharge to the surface waters surrounding the orchard, it is highly probable that SONC coho salmon will be exposed to chemical contaminants. In drawing conclusions about the potential for risk, both the lethal and sublethal effects analyses utilized the most sensitive toxicity data points (including data for the most sensitive life stage), and assumed that fish species would be present at the time of pesticide application.

Accumulation of Pesticides, Herbicides and Fertilizers in Soil. Impacts from the application of pesticides to soil can be divided into two groups - those occurring from chemicals which are highly mobile in soils and have a high water solubility, and impacts from chemicals with a low mobility in soil (high adsorption rate) and are only slightly soluble in water. High lipophilicity (fat solubility) of the pesticide is the primary driver for non-specific partitioning (sorption) into soil organics. True adsorption (binding to a specific site) also occurs, and positively charged pesticides and fertilizers tend to adsorb to clay particles (clays tend to have

[15] The Provolt orchard does not include aerial applications, though drift could occur from other application methods.

negative surface charges). Therefore, some pesticides and fertilizers with high water solubility can be adsorbed by soils with significant clay content.

Most chemicals proposed for application have a low mobility in soil due to a higher rate of adsorption. These chemicals would likely remain near the surface of the soil and degrade over time. Most degradation occurs by microbial metabolism. Other methods of degradation include hydrolysis (the splitting of a molecule by the addition of the elements of water), photolysis (degradation by radiant energy), and chemical degradation. Except the herbicide picloram which has a soil half-life in the 5- to 6-month range, the soil half-life of most of these chemicals is less than three months.

Three of the pesticides proposed for application at Provolt are highly mobile in soil: Dimethoate, dicamba, and picloram. The RA predicted that none of these would leach into the groundwater in Central Point or Kerby soils at Provolt. The application of the pesticides would not use a sufficient amount of water to move chemicals past the surface of the soil and the timing of the proposed pesticide considers forecasts for precipitation (an application rate of 50 to 150 gallons per acre of water mixed with the chemical would be equivalent to about 0.02 to 0.05 inches of water applied to the area). Any applied pesticides would likely remain near the surface and begin degrading, until subsequent rainfall or irrigation moves any remaining residues into the soil horizon. Mobile pesticides leaching through the soil column would migrate into groundwater. Photodegradation and metabolism by soil microbes would no longer be viable degradation pathways, and half-lives in groundwater could become substantially longer.

The GLEAMS modeling conducted for the RA indicates that negligible accumulation was expected. The long period of simulation (10 years with application assumed to occur annually) allowed an evaluation of the tendency for a chemical's environmental persistence, if residues remain after one year, to contribute to an increased concentration in runoff or leachate in later years. This conservative assumption is inherent in the stream concentrations estimated to result from any pesticide loss in runoff from treated areas.

Fertilizers. Fertilizers are used to optimize seed production in the seed orchards. Fertilizers are to be distributed over the ground using a broadcast spreader pulled by a truck or mounted on a tractor or ATV. Several types of fertilizers are proposed for use at Provolt: Ammonium nitrate, ammonium sulfate monoammonium and diammonium phosphate, calcium nitrate, potassium nitrate, potassium chloride, and potassium sulfate. Most of these fertilizers are very soluble in water and can contribute ammonia and nitrates in runoff to surface waters.

Ammonia in the runoff can exist in its ionized form (NH4+), and in its un-ionized form as ammonia (NH3). The equilibrium between these two forms is largely dependent on pH and temperature. Un-ionized ammonia is the more toxic form, because it is a neutral molecule and thus is able to diffuse across the epithelial membranes of aquatic organisms much more readily than the charged ammonium ion (USEPA 1999). However, the ammonium ion is generally present in much greater concentrations and can also contribute to ammonia toxicity under some

conditions. The RA modeling analysis assumed the most conservative situation and considered all of the ammonium in the runoff to be in the more toxic unionized form (NH3).

Ammonia is of much concern due to its relatively toxic nature and its ubiquity in waterbodies. Ammonia occurs in natural waters secreted by aquatic plants and animals, and generated by heterotrophic bacteria as the primary end product of decomposition of organic matter (Randall and Tsui 2002). As aquatic plants and animals die, bacteria break down large protein molecules containing nitrogen into ammonia. Ammonia is then oxidized by specialized bacteria to form nitrites and nitrates.

Concentrations of ammonia acutely toxic to fishes may cause loss of equilibrium, hyper-excitability, increased breathing, cardiac output and oxygen uptake (USEPA 1986). In extreme cases, damage to the central nervous system from acute levels can lead to convulsions, coma, and death (Randal and Tsui 2002). Other mechanisms of ammonia toxicity were outlined by Ruffier *et al.* (1981) to include gill damage leading to suffocation, osmoregulation dysfunction (bloating) causing kidney failure, and inhibition of ammonia excretion leading to neurological and cytological failure.

At lower concentrations, ammonia has many sublethal effects on fishes, including a reduction in hatching success, increased respiratory distress, hormonal dysfunction, reduction in growth rate and morphological development (Rice and Bailey 1980, Soderberg *et al.* 1983, USEPA 1986, USEPA 1999). The literature also contains some information concerning the effects that chronic exposure to low levels of ammonia can have on the structure and function of select tissues and organs such as gills, livers, and kidneys and their increased susceptibility to disease (Soderberg *et al.* 1983; USEPA 1986; USEPA 1999). Behavioral effects to chronic levels of ammonia are reduced swimming stamina and performance which would affect predator avoidance and foraging behaviors (USEPA 1999).

The elevation of nitrogen in a stream has the potential to influence primary and secondary production altering the type and abundance of food available to salmonids. Nitrogen can promote the growth of periphyton, which in turn may influence the production of invertebrates and fishes (Spence *et al.* 1996).

Macro-invertebrates are reportedly less sensitive to ammonia than fish species (USEPA 1986). Flow-through tests determined that ammonia was acutely toxic to 19 freshwater macro-invertebrate species at concentrations ranging from 0.53 to 22.8 mg/L, whereas ammonia toxicity to 29 fish species ranges from 0.083 to 4.60 mg/L (USEPA 1986).

The proposed action would preclude fertilizers within 50 feet of waterways as a measure to reduce delivery to aquatic systems. This distance would act as a preventative measure to reduce runoff to surface water as the additional ground will sorb fertilizer compounds.

Temperature. Of the water quality factors assessed in this project, the combination of heat and other stress factors is most likely to compromise salmonid immune system function

(Hardie *et al.*, 1994; Kollner and Kotterba 2002; McCullough 1999). Likewise, exposure to environmental pollutants can decrease tolerance to temperature extremes (Paladino *et al.*, 1980). Subcellular and molecular changes such as enzyme induction are known to precede observable individual or population level effects (Boon *et al.*, 1992).

Glyphosate toxicity to rainbow trout increases with higher test temperatures (Folmar *et al.,* 1979). Toxicity also increased from pH 6.5 to 7.5, but did not change up to pH 9.5. Increasing temperature and pH with exposures to picloram resulted in greater toxicities to cutthroat trout and lake trout (Woodward 1976). Rainbow trout became more sensitive to permethrin with increasing water temperature (Kumaraguru and Beamish 1986). The 96-hour LC50 values decreased by nearly an order of magnitude (0.0064 to 0.00069 mg/L) between 10 and 20˚C, respectively.

Higher temperatures can also shift the equilibrium of ammonia species to its more toxic un-ionized form. The concentration of un-ionized ammonia present in an ammonia solution has been calculated to double in a 10˚C rise in temperature (Ruffier *et al.,* 1981). While the effects of temperature on the mechanism of ammonia toxicity is not well understood, the increased bio-availability to the more toxic unionized ammonia can increase the risk of fertilizers to salmonids.

Mixture Toxicity. Aquatic organisms can be exposed to complex mixtures of contaminants resulting from pollution that originates from industrial, agricultural, and domestic land use. Eco-toxicological studies that assess the effects of contaminants to aquatic communities typically have been limited to assessing the impacts of individual toxicants only. However, discrete assessments of individual toxicants do not capture the true exposure routes and effects to species which occupy habitat that is subject to multiple temporal and spatial chemical discharge. For salmonids who occupy diverse habitat types throughout each life history stage, exposure to chemical mixtures can occur within the water column, and from contaminated sediments and food. Given these complexities, consideration must be given to the potential that a wide variety of chemicals might be simultaneously present in complex mixtures.

Furthermore, these mixtures of chemicals likely contribute to reduced productivity of some aquatic ecosystems. For instance, Arkoosh *et al.*, (1991) found that juvenile Chinook salmon that migrated through waters contaminated with PCBs and PAHs, and heavily influenced by an urban landscape, bioacccumulated the pollutants, and showed signs of suppressed immune responses compared to uncontaminated fish. Casillas *et al.,* (1993) found that juvenile Chinook in urban waters showed suppressed immune function, reduced survival, and impaired growth as they migrated to the oceanic environment. More recently, a pilot study by the NWFSC revealed significant pre-spawn mortality of coho salmon within a highly urbanized watershed within the City of Seattle, as compared to a relatively non-urbanized stream within the Stillaguamish River Watershed. It is thought that pollutant mixtures delivered to the urbanized watershed through contaminated stormwater contributed to the high level of pre-spawn mortality, though the exact causes of mortality have not been fully determined to date.

Multiple chemicals that co-occur in aquatic systems may alter their toxicity by additive, antagonistic, or greater than additive (synergistic) effects (Denton *et al.* 2002). An additive effect occurs when the combined effect of several chemicals is equal to the sum of individual effects of each chemical as if they were alone (Klassen 1986). Antagonistic effect occurs when a mixture contains chemicals that interfere with each other's actions, or with the action of the other chemical. A greater than additive (synergistic) effect occurs when the combined effect of two chemicals is much greater than the sum of the effect of each agent individually (Klassen 1986). A special form of synergism is potentiation, which occurs when one substance has no toxic effect in and of itself, but when added to another chemical it enhances the toxicity of the toxic component (Klassen 1986).

Predicting Mixture Toxicity. It is necessary to examine the interactions or non-interactions of toxicants when characterizing and predicting the risk of chemical mixtures to ESA-listed salmonids. Predictive assessments of the aquatic toxicity of chemical mixtures are represented by numerous methods and models that are presented in several fields of pharmacology and toxicology (Faust 2003). In essence, however, there are two different fundamental hypotheses on the functional relationship between the toxicity of single substances and those of combined toxicants (Faust 2003). Commonly, those hypotheses are called concentration addition and response addition.

The concentration addition model best describes the scenario of non-interactive, joint-action and is generally applied to chemicals that exhibit a similar mode of action. The individual components of a mixture act independently but produce the same or similar effects and can be expressed in terms of the other (Broderius *et al.* 1995). For example, the joint toxicity of diazinon and chlorpyrifos on *Ceriodaphnia dubia* was examined in a study by Bailey *et al.* (1997). The toxic interaction was evaluated by a Toxic Unit approach that compared the LC50 estimates associated with the mixtures with the LC50s of the individual pesticides when tested alone. The results suggested that diazinon and chloryprifos exert additive toxicity to *Ceriodaphnia dubia.* This is entirely reasonable given that both are metabolically activated organophosphorus pesticides and act similarly with respect to the inhibition of acetlycholinesterase (Bailey *et al.* 1997). The toxicity of s-triazine mixtures, herbicides that commonly interfere with photosynthetic electron transport, are found to also be accurately predicted by the concept of concentration addition (Faust et al. 2001). The study further demonstrated that low concentrations of individual triazines, that alone did not cause a statistically significant response, contribute predictably to the overall effects of multi-component mixtures. For an assessment of mixtures which have a common specific mechanism of action, these studies show that an assessment of mixtures solely by independent components can tend to underestimate its overall toxicity.

As an alternative concept to concentration addition, mixtures of chemicals composed of dissimilar toxicants with varying modes of action, can be analyzed via the response-addition model, for predicting toxicity (Faust 2001). These models are based on the assumption that each toxicant neither enhances or interferes with the other and contributes to a common response only if the concentrations of both substances exceed their respective thresholds (Broderius *et al.*

1995). In this case, the toxicity of a mixture is equal to the that of its most toxic component (Sharma *et al.* 1999) and that the relative effect of a toxicant remains unchanged in the presence of another chemical (Faust *et al.* 2001). This approach has been demonstrated to provide accurate predictions of single species toxicity when all underlying assumptions are fulfilled.

Faust *et al.* (2003) studied the situation of multiple exposures to biocides with strictly different specific mechanisms of action to freshwater algae. Both concepts of concentration addition and response addition was applied to predict mixture toxicity. The concentration addition approach tended to overestimate mixture toxicity showing that the response addition approach proved to be superior when mixture components are well known to interact specifically with different molecular target sites.

However, developing scientific research indicates that simple concentration addition and response addition models are not always good predictors of the toxicity of mixtures. In many cases the effects of mixtures cannot be predicted from single components. Pape-Lindstrom and Lydy (1997) demonstrated that the response addition model does not always accurately predict the mixture toxicity of chemicals with dissimilar modes of action. In their experimental design, larvae of the aquatic midge (*Chironomus tendons*) were exposed to binary combinations of atrazine and various organophosphate insecticides. Their results conclusively show a greater than additive response for several combinations of chemicals that have dissimilar modes of action. Mixtures that result in greater than additive (synergistic) toxicity are of much concern due to unpredictability based on the effect of individual components (Woods *et al.* 2002).

The complex interactions that result from a mixture are generally between the chemicals and the physiological systems within the body, rather than between the chemicals themselves (Marking 1985). Examples of such interactions are the alteration of the absorption, distribution, biotransformation, or excretion of one chemical by another. There are two currently recognized mechanisms of greater than additive (synergistic) toxicity that involve such interactions, the increase in enzymatic activation of the other pesticide and the inhibition of enzymes responsible for detoxification (Woods *et al.* 2002).

In the metabolism of an organic pesticide, enzymatic activity induces a series of chemical alterations, in a process called biotransformation. The process of biotransformation can be divided into 'phase I' and 'phase II' metabolism. The first involves a change in the molecular structure of a pesticide by involving either hydrolysis, oxidation, or reduction (Sipes and Gandolfi 1986). Phase II biotransformation involves the conjugation of a substrate to endogenous pesticides (Boon *et al.* 1992). The end result of these reactions is that the metabolites are chemically distinct from their parent pesticide. Metabolites are usually more hydrophilic than their parent pesticide which restricts the partitioning of metabolites into cellular membranes, decreases reabsorption and facilitates eventual elimination (Sipes and Gandolfi 1986). The ease of which pesticides are eliminated depends on their water solubility. This explains why lipophilic pesticides, like dioxins, are readily absorbed, poorly excreted, and have a tendency to accumulate.

However, it is important to note that biotransformation can result in higher toxicity (Boon *et al.* 1992). For example, several organophosphorus insecticides such as chlorpyrifos, methyl-parathion, and malathion are in of themselves poor inhibitors of acetylcholinesterase. However, upon phase I metabolic conversion, their corresponding oxygen analogs are highly potent acetylcholinesterase inhibitors. The rate of metabolic activation to a pesticide of higher toxicity can be increased by the presence of other chemicals in a mixture (Woods *et al.* 2002). This can help explain the greater than additive toxicity noted for combinations of organophosphorus insecticides and other pesticides.

Inhibition of enzymes that are responsible for detoxification will result in increased levels of active pesticide to interact with target sites (Woods *et al.* 2002). Carboxylesterases are an important class of serine hydrolases that cleave esters into the corresponding alcohol and acid. They can serve an important function by detoxifying pyrethroids and other ester containing pesticides such as herbicides (Denton *et al.* 2002). However, carboxylesterases can be inhibited by organophosphates and carbamates. Mixtures of organophosphates and pyrethroids could potentially exhibit a synergistic toxicity. Denton *et al.* (2002) examined joint mixture toxicity of diazinon and esfenvalerate to fathead minnows. The observed greater than additive (synergistic) toxicity was attributed to inhibition of carboxylesterase activity by diazinon, a potent organophosphate.

Provolt Mixture Analysis. The concept of concentration addition has been used to quantitatively analyze the effect of simultaneous exposure of pesticides to salmonids from pesticide application at Provolt. Additive action is the most common form of mixture toxicity (Marking 1985), and would be very relevant considering the type of pesticides used at Provolt. Greater than additive or less than additive interactions would be exceptions and are difficult to predict.

Concentration addition is expressed mathematically as: $$\sum_{i\text{-}1}^{n} \frac{C_i}{EC_{X_i}} = 1$$

For a multi-component mixture of n substances: c_i is the concentration of the individual substances present in a mixture or dose, ECx_i is the equivalent effect concentrations of the individual substance. The equivalent effect concentrations must be similar in the respect of the assessment endpoint for this approach to hold scientific relevance. The quotients resulting from c_i/ECx_i would then represent the concentrations of individual mixture components as fractions of equitoxic concentrations scaled for its relative potency TU (toxic unit). By summing the toxic units, the toxic strength of a mixture of pesticides may be determined.

For example, assume a chemical mixture of pesticide A and B with similar modes of toxic action occurs. The known environmental concentration or dose of A, is divided by the toxicity of A (LC50 or other relevant endpoint), which will result in a unitless fractional toxic unit for A. The same procedure is followed for each component in the mixture. The summation of toxic units A

and B carries a result that approaches 1. If 1 is reached, then it can be assumed that there is additive toxicity on the acute level.[16]

Concentration addition implies that every toxicant in any concentration contributes, more or less, to the overall toxicity of a mixture, and holds the assumption that the chemicals in a mixture exhibit a similar mode of action. There are two major pesticide groups proposed for use in Provolt that fulfill these requirements. The organophosphate insecticide group: Acephate, diazinon, chlorpyrifos, and dimethoate, all act similarly in the inhibition of acetylcholinesterase, and the pyrethroid insecticide group: Esfenvalerate and permethrin, which act similarly in the blocking of neural voltage-activated sodium/calcium channels. For the purpose of this analysis it is assumed that these groups of pesticides would be simultaneously present in salmonid habitat at modeled concentrations from erosion, runoff, and drift.[17] Traditionally, each pesticide group would undergo a separate analysis. In the BLM BA, these pesticides were analyzed individually without consideration to the overall toxicity of a mixture.

Within this analysis, the toxic unit approach described above was used to assess the groups of similarly acting pesticides (organophosphates and pyrethroids) in a specific waterbody using the maximum BLM-modeled concentrations due to drift, runoff, and erosion. For instance, as seen in Table 2, esfenvalerate is proposed to be applied within the April to July period annually, using high-pressure hydraulic sprayer, a hydraulic sprayer with hand-held wand and/or a backpack sprayer.

The BLM-modeled estimates of water concentrations from each application type from drift and runoff were then summed. This summation is not unrealistic, because during most of the application window precipitation levels are low relative to other periods, and generally continue to decrease per month, thus reducing the likelihood of runoff delivery facilitated by individual rain events, and individual applications. As such, most delivery to the drainages of Provolt of esfenvalerate applied from April through July could occur in zone three (September through December) when precipitation increases and overland flow is more likely. Summation of these individual model results is logical and represents a hypothesis of plausible exposure concentrations to SONC coho within the listed waterways.[18]

The equivalent effect concentrations of the individual substances were taken from the scientific literature pertaining to the assessment endpoint in question. As depicted in Table 10, after a toxic unit was calculated for each model concentration, they were summed up to give a final

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[16] Acute mortality data (LC50s) were used as the equivalent effect concentrations of the individual substances. Sublethal or LOEC data can also be used if available.

[17] The highest concentrations in these streams were identified (Table 8-1 in the BA), and can be considered to represent 24-hour average concentrations.

[18] Note that chemical degradation, or binding to soils, may dilute concentrations or delay delivery to surface waters.

toxic unit. As mentioned before, as the final toxic unit approaches one, we can expect acute effects.

Table 10. Mixture Toxicity for Fish Species Within Receiving Waterways

Chemical	App Method	Bridgepoint Ditch (mg/L)	Laurell Hill Ditch (mg/L)	Williams Creek (mg/L)	Applegate River (mg/L)
Organophosphate group					
Acephate	HPHS runoff&erosion	0	0	0	0
Chlorpyrifos	HPHS & HHW	1.62e-05	1.91e-06	2.07e-06	8.03e-07
Diazinon	HPHS runoff&erosion	3.24e-08	2.04e-08	3.61e-08	2.36e-09
Dimethoate	HPHS runoff&erosion	0	0	0	0
	TU Summation	**1.63e-05**	**1.93e-06**	**2.1e-06**	**8.06e-07**
Pyrethroid group					
Esfenvalerate	HPHS runoff&erosion	0	2.48e-09	7.93e-10	1.22e-09
	HHW&BP runoff&erosion	0	9.25e-10	1.00e-09	3.90e-10
Permethrin	HPHS runoff&erosion	0	2.10e-09	6.69e-10	1.16e-09
	HHW&BP runoff&erosion	0	1.62e-11	1.75e-11	6.82e-12
	TU Summation	**0**	**2.48e-09**	**1.00e-09**	**1.22e-09**

* Permethrin and Esfenvalerate will not be used in the same year, and only one application method would be used in a year. Note that in each waterway, only one methodology for the pyrethroid group is summed, reflecting the worst case scenario within the proposed action.

Numerical values represent scientific notation.

Referring to Table 10, for the pyrethroid insecticides with common mode of action, the Provolt seed orchard managers have proposed to not use permethrin and esfenvalerate in the same year and in addition, to only use one application method. Therefore, for pyrethroids, only the worst case scenario is analyzed for the mixture analysis, which is a mixture of only one constituent.

The final toxic units for organophosphates and pyrethroids within Bridgepoint Ditch, Laurell Hill Ditch, Williams Creek, and Applegate River are extremely low, several orders of magnitude below where we expect there to be an acute effect to fish species. However as recognized in the

environmental baseline, additional pesticides outside of this analysis are likely to increase the mixture toxicity reported in this table.

Table 11. Mixture Toxicity for Macroinvertebrates Within Receiving Waterways

Chemical	App Method	Bridgepoint Ditch (mg/L)	Laurell Hill Ditch (mg/L)	Williams Creek (mg/L)	Applegate River (mg/L)
Organophosphate group					
Acephate	HPHS runoff&erosion	0	0	0	0
Chlorpyrifos	HPHS & HHW	4.87e-04	5.72e-05	6.20e-05	2.41e-05
Diazinon	HPHS runoff&erosion	3.52e-06	2.22e-06	3.92e-06	2.55e-07
Dimethoate	HPHS runoff&erosion	0	0	0	0
	TU Summation	**4.91e-04**	**0**	**6.59e-05**	**2.44e-05**
Pyrethroid group					
Esfenvalerate	HPHS runoff&erosion	0	8.27e-05	2.64e-05	4.07e-05
	HHW&BP runoff&erosion	0	3.08e-05	3.33e-05	1.30e-05
Permethrin	HPHS runoff&erosion	0	5.38e-06	1.72e-06	2.97e-06
	HHW&BP runoff&erosion	0	4.15e-08	4.49e-08	1.75e-08
	TU Summation	**0**	**8.27e-05**	**3.33e-05**	**4.07e-05**

*Permethrin and Esfenvalerate will not be used in the same year, and only one application method would be used in a year. Note that in each waterway, only one methodology for the pyrethroid group is summed, reflecting the worst case scenario within the proposed action.

Numerical values represent scientific notation.

Referring to Table 11, for the pyrethroid insecticides with common mode of action, the Provolt seed orchard managers have proposed to not use permethrin and esfenvalerate in the same year and in addition, to only use one application method. Therefore, for pyrethroids, only the worst case scenario is analyzed for the mixture analysis, which is a mixture of only one constituent.

Macroinvertebrates are generally more sensitive to pesticides than salmonids. We would expect to see similar toxic effects as before but magnified. Referring to Table 11, the final toxic units for organophosphates and pyrethroids within Bridgepoint Ditch, Laurell Hill Ditch, Williams Creek, and Applegate River are extremely low, several orders of magnitude below where we

expect there to be any acute effects to macroinvertebrates. However as recognized in the environmental baseline discussion, there is potential for additional pesticides outside of this analysis to increase the mixture toxicity reported in this table.

Prey Base Effects and Bioaccumulation. It is becoming increasingly evident that the indirect effects of contaminants on ecosystem structure and function are a key factor in determining a toxicant's cumulative risk to aquatic organisms (Preston, 2002). As mentioned within the analysis of the family of pesticide above (as applicable), adverse effect to salmonid prey base can occur from exposure to some substances. Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the acutely toxic effects of herbicides. Therefore, chemicals can potentially impact the structure of aquatic communities at concentrations that fall below the threshold for direct biological impairment in salmon. The integrity of the aquatic food chain is an essential biological requirement for salmon and steelhead, and the reasonable likelihood herbicide applications will reduce the productivity of streams and rivers is a significant adverse effect.

Pesticide, herbicide and fertilizer effects to salmonid prey base typically occur through two primary mechanisms: (1) Effects to the amount and/or type of food supply; or (2) by pesticide exposure via food organisms. Depending on the exposure scenario, effects to aquatic invertebrate communities can be very short-term, or take months or years to fully recover. Pesticide exposure via food organisms is likely to be much more episodic and short-term. Norris *et al.* (1991) provide a summary and literature review of pesticide and fertilizer effects to salmonids. The amount and/or type of food supply can be altered by pesticides and fertilizers in complex and subtle ways, particularly if the aquatic system is exposed to a combination of insecticides, herbicides, and fertilizers.

Insecticides can alter the prey base by direct mortality of aquatic invertebrates. Insecticides are typically more toxic to fish and other aquatic organisms than herbicides, but are generally applied at lower rates (Beschta *et al.* 1995). Insecticides can cause direct mortality of aquatic invertebrates, or trigger extensive drift of aquatic invertebrates out of the affected area (Spence *et al.* 1996). If grazing invertebrates are reduced or eliminated from a stream reach, primary production release may occur (such as algal blooms), altering trophic structure.

Herbicides are often not highly toxic to salmonids, as they are generally designed to interfere with physiological systems unique to plants. However, low concentrations of herbicides may exert significant effects on salmonid prey items by affecting algal or aquatic plant communities (Pratt *et al.* 1997), or directly on salmonids through sublethal effects of the herbicide (Spence *et al.* 1996). In addition, some herbicides are moderate to highly toxic to aquatic invertebrates, such as triclopyr ester (SERA 2003b), and adjuvants and surfactants present in herbicide commercial formulations can greatly enhance toxicity (Stark and Walthall 2003; SERA 1997). Fertilizers can also affect salmonid food supply by increasing algal and other aquatic plant growth, altering the aquatic invertebrate community.

Salmonid pesticide exposure through food organisms can occur through incidental exposure of terrestrial insects which subsequently become prey items for fish (Norris *et al.* 1991), or indirectly through invertebrate ingestion of organic material delivered to the aquatic system (Urban and Cook, 1986). Pesticides which are more lipophilic (fat soluble) will tend to partition into organic material in or on soil. Runoff can mobilize organic material into streams where it is consumed by insects and crustaceans. Little data is available on the risk of exposure via this pathway, but risk is likely to be highly variable depending on conditions at the time of application, such as seasonal timing.

Bioaccumulation in fish is partially mediated by the presence of insecticides and herbicides in food items and sediment residues, but also includes bioconcentration, defined as passive uptake from the water column (Klaassen *et al.* 1986). The lipophilicity of the pesticide and fat content of the organism are the primary factors determining the extent of bioaccumulation. Pesticides with high lipophilicity tend to partition out of the water column and into food items, with the degree of partitioning proportional to the organism fat content. Concentration up the food chain (biomagnification) occurs when repeated exposure through consumption of contaminated prey items results in high concentrations of pesticide in predators, such as salmonids. For bioaccumulation to occur, a pesticide must have sufficient lipophilicity and persistence, and relatively low acute toxicity. Within the BA, the potential for bioaccumulation of degradates and metabolites is not addressed.

The possibility of adverse effects from additive, antagonistic or synergistic effects from multiple applications exists. The relative risk of these type of adverse effects depends on the volume and timing of their delivery, and background water quality conditions. Within the zones of possible exposure periods described above, the greatest likelihood of additive/synergistic effects from applications would occur anytime precipitation events cause significant subsurface or overland flow delivery to aquatic systems. The volume and types of pesticides delivered would depend on the relative success of CPs to inhibit off-target delivery. At Provolt, it is thought that the greatest potential for this pathway of adverse effects would occur in zone two (May through September) and zone three (October though December). As precipitation levels rise, subsurface and from Provolt (overland flow may occur, but is not likely due to the topography at the orchard) will increase, thus pesticide delivery to the Applegate River and Williams Creek is reasonably likely to occur. As previously mentioned, model results are derived from a number of conservative assumptions, and NMFS utilized the maximum application rate scenario, and assumed that the application frequency listed in Tables 8 and 9 would actually occur.

Cultural, Biological, and Physical Methods. The cultural, biological, and physical pest treatments are unlikely to have measurable effects, due to the small amount of area where these treatments would be applied, and the very limited amount of disturbance to riparian soils and native vegetation communities the treatments are expected to create. Cultural and biological controls have very little potential to effect salmonids or their habitat. Cultural controls are preventive measures to reduce the risk of introduction or dissemination of weeds. They do not involve ground-disturbing activities. Biological controls use insects and pathogens determined to be host-specific, highly damaging to targeted species, able to survive in the host's habitat, free

of natural parasites, and not likely to be parasitized in the host plant's habitat. Biological controls pose no foreseeable risk to salmonids or their habitat. Physical controls involve ground disturbing activities (pulling or cutting of weeds). However, the scope and magnitude of this action is so limited that any effect to salmonids or their habitat is considered negligible. The use of prescribed burns is limited to non-riparian areas. Provided that proper treatment methods (*i.e.*, burn containment and timing) are used, there would be very little potential for adverse effects.

Establishment of Monitoring Criteria. The following pesticides proposed for use at Provolt (Table 12) posed the largest threat to aquatic organisms and habitat. The close monitoring of these contaminants is necessary in order monitor the effectiveness of CPs and the Terms and Conditions of this Opinion.

Low and high triggers for reinitiation were established by considering LC50 values taken from the scientific literature, and dividing by 20 to create a 'low trigger,' and by 2 to create a 'high trigger.'

The low trigger reflects a conservation measure that attempts to reduce, though not avoid, sublethal effects in coho salmon. A high trigger reflects a concentration in which direct mortalities may occur which is not authorized in this Opinion. The low trigger levels are those estimated dissolved contaminant concentrations in water, which can be surpassed a single time, for one compound, during each of the three annual precipitation and application zones as displayed within the Opinion (Figure 2 and Table 7). Thus, a total of three annual exceedances of the low trigger are allowed per year, one during each period.

A high trigger reflects a concentration in which direct mortalities may occur which is not authorized in this Opinion. The high trigger values are those dissolved contaminant concentrations in flowing water at which acute lethality may occur. Meeting or exceeding these concentrations would require re-initiation of consultation.

The literature sources were agreed upon by NOAA and BLM and previously used by the BLM in an extensive effects analysis section of the BA. Detection limits of pesticides are also given if known. The low trigger and high trigger values may be revisited (and potentially revised) annually to incorporate new data regarding baseline conditions, and newly-published sublethal effects.

Table 12. Monitoring Triggers

Compound	Chemical Family	LC50 (PPB)	'low trigger'	'high trigger'	Detection Limit	LC50 Source
Chlorpyrifos	Organo-phosphate	3	0.15	1.5	0.04	EPA 1984
Dimethoate		6200	310	3100	0.8	EPA 1999
Diazinon		90	4.5	45	0.2	Johnson & Finley 1980
Permethrin	Pyrethroids	7	0.4	3.5	0.4	Holcombe *et al.* 1982
Esfenvalerate		0.09	0.0005	0.045	0.02	Curtis *et al.*, 1985
Propargite	Organo-sulfite	118	5.9	59	0.4	EPA 2000
Trichloropyridnol (Triclopyr and chlorpyrifos degradate) picloram[19]	Pyridine derivatives	1500	75	750	?	Wan 1988
Chlorothanil	Chlorinated-benzene nitrile	42	2.1	21	0.04	EPA 1999

Semi-Permeable Membrane Devices (SPMDs). SPMDs shall be deployed to monitor instream waterborne concentrations of pesticide contaminats. The SPMD is an instream 'accumulator' which allows calculation of an average chemical concentration during the period of deployment.

SPMDs provide a time-weighted average concentration for the chemicals of interest and only measure the dissolved and, therefore, the readily bioavailable fraction. The contaminants of highest concern (pyrethroids and organophosphates) are highly hydrophobic and exhibit high Koc-binding affinities. These contaminants are likely to bind to available particulate organic carbon and ultimately move as particles in marine, freshwater, and estuarine ecosystems. Thus, the SPMD data will capture only a small fraction of these contaminants that actually enters the waterbody. Contaminants sequestered by particulate organic carbon are not sampled and are still available to enter food webs, or play significant roles in habitat forming processes. However, SPMDs successfully monitor the dissolved waterborne concentrations of contaminants that are

[19] Trichloropyridnol (TCP) is a degradate of both chlorpyrifos and Triclopyr, that is classified as moderately toxic to fish. As a moderately toxic, common degradate of two of the pesticides applied, with a half-life ranging from 12 - 229 days, TCP poses a risk to ESA-listed salmonids greater than or equal to some of the pesticides applied. Therefore, TCP was added to the list of compounds to be monitored.

immediately bioavailable to ESA-listed species. Thus, they are a reliable source of information on the effectiveness of conservation practices to reduce exposure and eliminate any chance of acute mortalities.

Critical Habitat Effects. SONC coho salmon critical habitat was designated May 5, 1999 (64 FR 24049). SONC coho salmon critical habitat encompasses accessible reaches of all rivers, including estuarine areas and tributaries, between the Mattole River in California, and the Elk River in Oregon, including all waterways and substrate below longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for at least several hundred years).

The critical habitat designation focused on essential habitat features which included spawning sites, food resources, water quality, water quantity, and riparian vegetation. The proposed IPM has the potential to affect food resources and water quality.

NMFS expects short term and sporadic degradation of water quality from pesticide drift soon after some individual applications. Because these short-term and sporadic degradations are anticipated to occur infrequently, habitat-related changes from drift of pesticides are not expected to occur; riparian and aquatic vegetation quantity and diversity loss are unlikely. Food sources, such as aquatic invertebrates, are generally more sensitive to chemical habitat alteration than fish. Water quality degradation from drift may result in isolated and temporal losses of benthic production.

Surface water runoff delivery of pesticides, expected to sporadically occur in relation to seasonal rises in precipitation, may deliver pesticides to surface waters for longer periods. This delivery, while possibly at lower concentrations than drift, may result in greater loss of aquatic plant and benthic production, depending on the duration and concentration of exposure.

Finally, if pesticide use is effective at controlling targeted pest, it is possible that aquatic food sources could be diminished in areas occupied by SONC coho. At least some of the targeted insects (and non-targeted insects as well) would be expected to enter the aquatic food chain within some period of their life-cycle. This entry to the aquatic food chain, either randomly or through a necessary life-stage would represent possible prey. Food loss within critical habitat could reduce its conservation value. In addition, some insects exposed to chemicals could nonetheless enter the food chain within critical habitat. These insects would likely be harmful food sources.

The combination of alternative pest management methods that pose no risk to critical habitat (*i.e.* biological controls such as bat boxes), and proper implementation of application setbacks from surface water, CPs, and proper timing of application within least-risk weather periods (*i.e.* minimal wind and change of rain) are expected to preclude multiple and relatively large volume non-target delivery of pesticides to surface water. Finally, the monitoring and adaptive management regime will gauge the relative effectiveness of these measures, preclude chronic water quality degradation, and facilitate changes in BLM operations to enhance protective measures in light of new information. Such new information could include new literature on

sublethal effects to fish and their prey base, baseline conditions within the receiving waterways, and drift card and water sampling data in conjunction with certain applications, among other data. Consequently, NMFS does not expect that the net effect of these actions will diminish the conservation value of designated critical habitat for recovery of SONC coho salmon.

Cumulative Effects

Cumulative effects are defined in 50 C.F.R. 402.02 as 'those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.' Other activities within the watershed have the potential to impact fish and habitat within the action area. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and certain land management activities are being (or have been) reviewed through separate section 7 consultation processes with a variety of Federal action agencies.

Within this Opinion, cumulative effects have been analyzed from the context of future pesticide use and pollutant discharge (and other water quality degradation) to surface waters from non-Federal land use. Such land uses include urban and suburban, commercial forestry and agriculture.

While general land use is known, details of pesticide and fertilizer application amounts and acres treated are not well documented for the Rogue River Basin upstream and downstream from the project area. However, pesticide application rates for various crops grown in the Rogue River Basin have been documented (Jenkins 1999), as displayed in Table 13.

Table 13. Rogue River Agriculture and Associated Pesticides

CROP:	**Alfalfa**	**Apples**	**Barley**	**Corn, silage**	**Corn, sweet**	**Grapes**	**Oats**	**Pears**	**Squash, pumpkin**	**Tomato, Bell Pepper, Eggplant**	**Wheat**	**total**
Planted Acres:	**9,200**	**638**	**1,328**	**550**	**128**	**500**	**178**	**7,100**	**35**	**99**	**2,081**	**total: 21,837**
Pesticide (lbs. a.i.):												
2,4-D				20				500			20	
2,4-DB	100											
ABAMECTIN								485				
ALACHLOR				20	20							
AMITRAZ								6,118				
ATRAZINE				10	10							
AZINPHOS-METHYL		3,000						30,000				
B. T.										15		
BENOMYL											25	
BENTAZON				38								
BROMOXYNIL	60		123				16				284	
CAPTAN				10	10							
CARBARYL	20	19				20						
CARBOFURAN						29						

CROP:	**Alfalfa**	**Apples**	**Barley**	**Corn, silage**	**Corn, sweet**	**Grapes**	**Oats**	**Pears**	**Squash, pumpkin**	**Tomato, Bell Pepper, Eggplant**	**Wheat**	**total**
Planted Acres:	**9,200**	**638**	**1,328**	**550**	**128**	**500**	**178**	**7,100**	**35**	**99**	**2,081**	**total: 21,837**
Pesticide (lbs. a.i.):												
CARBOXIN			36								56	
CHLORAMBEN									26			
CHLORPYRIFOS		100		55	37			600				
CHLORPYRIFOS-METHYL											56	
CLOFENTEZINE								125				
COPPER								30,000		10		
DIAZINON								971				
DICAMBA			84				12				133	
DICLOFOP			574								896	
DIFENZOQUAT											103	
DIMETHOATE											24	
DIURON	100	125	15			50		8,000			1,472	
DODINE								35,000				
ENDOSULFAN								2,000				
EPTC	100			50								
ESFENVALERATE					10			600				
ETHALFLURALIN									32			
ETHEPHON											10	
ETHOPROP				55	43							
FENARIMOL		51						245				
FENBUTATIN-OXIDE								1,664				
FONOFOS				122	53							
FORMETANATE HYDROCHLORIDE								500				
GLYPHOSATE	138			28		219		976	22	30	16	
HEXAZINONE	644											
IPRODIONE						300						
LIME SULFUR		81						60,000				
MALATHION						51						
MANCOZEB								20,000			33	
MANEB										162		
MCPA			653				120				1,106	
METALAXYL				10	10					27		
METOLACHLOR				139	74			39				
METRIBUZIN	1,380		141								227	
MYCLOBUTANIL		81										
NAA								414				
NAPROPAMIDE						37						
NICOSULFURON				10								
NORFLURAZON								59				
OIL		6,960						65,000				
ORYZALIN		132				10		1,730				
OXYTHIOQUINOX								70				
PARAQUAT	100			12		54		400				
PHORATE											41	
PHOSMET		435						18,000				
PRONAMIDE	644											
PROPARGITE				11								
PROPICONAZOLE											50	
SETHOXYDIM	276											
SIMAZINE		169				221		2,958				

CROP:	Alfalfa	Apples	Barley	Corn, silage	Corn, sweet	Grapes	Oats	Pears	Squash, pumpkin	Tomato, Bell Pepper, Eggplant	Wheat	total
Planted Acres:	9,200	638	1,328	550	128	500	178	7,100	35	99	2,081	total: 21,837
Pesticide (lbs. a.i.):												
STREPTOMYCIN				10	10			8,000				
SULFUR	207					2,797						
THIFENSULFURON											10	
THIOBENDAZOLE								10				
THIRAM			36	10	10						56	
TRIADIMEFON						15		200			16	
TRIADIMENOL											15	
TRIALLATE											864	
TRIBENURON											13	
TRIFLURALIN											95	
VERNOLATE					12							
ZIRAM								15,000				
Total Pesticide (lbs. a.i.)	**3,769**	**11,153**	**1,662**	**610**	**299**	**3,803**	**148**	**309,664**	**80**	**244**	**5,621**	**337,053**

Data from Table 13 has been used to identify some of pesticides likely to be applied in the Applegate River and Williams Creek Valleys. The pesticides and their associated application rates for alfalfa and grape vineyards, the only two agricultural uses in the Applegate River and Williams Creek Watershed, are shown in Table 14. The possible discharge of these and other pesticides and fertilizers, while not the same as used by the Provolt seed orchard, contribute to an elevated pollutant level that could result in harm to ESA-listed salmonids. Interactions with these chemicals and known organophosphate pesticide releases further exacerbate the risks. The relative pathways of effects to salmonids are similar to the 'Mixture Toxicity' section of this Opinion.

Table 14. Pesticide Application Rate (lbs a.i./acre) by Crop: Applegate and Williams Creek Watersheds

Pesticide	Alfalfa	Grapes
Napropamide	--	0.07
Orzyalin	--	0.02
Simazine	--	0.44
Sulfur	0.02	5.59
Ziram	--	0.03
Metribuzin	0.15	--
Paraquat	0.01	--
Sethoxydim	0.03	--
Pronamide	0.07	--

a.i.: active ingredient

Aside from the above data, there is a logical deduction that the various types of agricultural land use incorporate pesticides into their land management programs, although the timing, quantities and frequency of applications are unknown at this time. As noted in the Provolt (draft) EIS, the Applegate River receives return flows from irrigated agriculture and other uses. Return irrigation flows are likely to provide more efficient delivery of pesticides and nutrients than typical subsurface runoff.

From the above discussion, it is evident that some level of pesticides and adjuvants are likely to be already present in Williams Creek and the Applegate River. The number of compounds present most likely increases in the downstream direction, as runoff from cumulative agricultural and other land uses increases. The Rogue River Watershed has considerable amounts of agricultural land use, with associated pesticide application. Given the known water quality stressors (high summer water temperatures and low dissolved oxygen) facing rearing juvenile coho salmon in the Applegate River and Williams Creek, and the very likely, but unquantified, presence of pesticides from upstream applications, any additional exposure to toxic substances is very likely to adversely affect fish rearing within the area influenced by the proposed project.

Confounding this assessment are the above described sources of uncertainty, particularly the future non-BLM discharges of various pesticides, herbicides and fertilizers. Background concentrations of compounds from non-BLM applications are reasonably certain to persist over time. However, the recent U.S. District Court for the Western District of Washington decision that require buffers for certain compounds and streams could reduce the volumes and types of cumulative (non-BLM) discharges that occur in the action area, though the degree of improvement would be difficult to determine.

NMFS believes that baseline conditions within much of the action area will be subject to local changes in the short and long term. NMFS assumes that future private and state actions will continue at similar intensities as in recent years.

Conclusion

After reviewing the best available scientific and commercial information regarding the biological requirements and the status of the SONC coho salmon ESU considered in this Opinion, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify designated critical habitat.

These conclusions are based on the following considerations: (1) The BLM will use IPM to ensure that a combination of all available pest control strategies, including pesticide alternatives, are applied to keep pests below treatment thresholds while reducing the need for pesticide applications; (2) when chemical use is required, BLM will select the pesticide formula that is least toxic for fish and aquatic life while achieving management needs; (3) the application of chemicals will be timed to coincide with weather conditions that are least likely to result in riparian and aquatic contamination; (4) broad non-spray buffers will be observed to reduce the likelihood of significant quantities of pesticide will be transported to riparian and aquatic systems through drift, surface runoff, and groundwater runoff; (5) chemicals will be applied using precise methods designed to reduce the amount of pesticide loss; (6) a comprehensive sampling, monitoring, and analysis protocol will be used to ensure that the behavior and transport of chemicals in the environment are as predicted; (7) the proposed action includes an explicit process to quickly modify the proposed action based on any significant new information that may be developed through consultations now underway with the EPA regarding the effects of pesticides proposed for use during management of the Provolt seed orchard; and (8) all fertilizer applications will be applied at environmentally optimum rates designed to reduce the presence of fertilizer products in drainage water delivered to surface and groundwater systems

Conservation Recommendations

Section 7 (a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of habitats, or to develop additional information. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be carried out by the BLM. Information from the proposed recommendations will help to reduce uncertainty about the effects of past and ongoing human and natural factors leading to the status of ESA-listed salmon, their habitats, and the aquatic ecosystem within the action area.

1. The BLM should conduct or fund additional monitoring for toxic pesticides, including sediment sampling. Certain classes of pesticides and herbicides within the proposed action exhibit an affinity for binding to organic carbon molecules and are readily taken up in the sediments. Particulate-bound contaminants can still be available to enter freshwater food webs and provide a different exposure pathway for salmonids. The sediment sampling should occur within receiving waterways and near sources of known discharges. This data would assist in future ESA analysis for similar proposed IPM actions, and provide meaningful data for adaptive management of the proposed IPM.
2. The BLM should conduct or fund a study of non-pesticide-use IPM methods relative to pesticide-use effectiveness. The study should be tailored to determine the various production implications of these two approaches.
3. The BLM should enhance riparian functions along the Applegate River and Williams Creek through native plantings. Enhanced riparian areas could reduce risk of drift discharges, and increase shade and large wood input along these two waterways.
4. The BLM should either plant shrubs or tight-line irrigation ditches that flow through Provolt. These measures would reduce risk of compound discharges, and reduce the potential for thermal loading. The BLM should work with the local irrigation district to ensure that these ditches have sufficient juvenile fish screens installed and maintained, and to eliminate the annual construction of the push-up dam on Williams Creek.

To be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed SONC coho and their designated critical habitat, NMFS requests notification of the achievement of any conservation recommendations.

Reinitiation of Consultation

Consultation must be reinitiated if: (1) The amount or extent of taking specified in the incidental take statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 C.F.R. 402.16).

Monitoring data showing that pesticide residues exceed thresholds within the terms and conditions of this Opinion, are an example of new information that would require reinitiation.

If the BLM fails to provide specified monitoring information by November 15 of each year (excluding 2004), NMFS will consider that a modification of the action that causes an effect on listed species not previously considered and causes the incidental take statement of the Opinion to expire. Consultation also must be reinitiated five years after the date this Opinion is signed. To reinitiate consultation, contact the Oregon State Habitat Office of the Habitat Conservation Division of NMFS, and refer to NMFS No.: 2004/00207.

Incidental Take Statement

Section 9(a)(1) and protective regulations adopted pursuant to section 4(d) of the ESA prohibit the taking of listed species without a specific permit or exemption. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

Amount or Extent of the Take

Individuals of SONC coho salmon will be present in the action area during part of the year when actions necessary to carry out the Provolt Seed Orchard IPM are likely to release pesticides that will travel into streams and rivers occupied by this ESA-listed species and their prey. As discussed in this Opinion, pesticides released into those streams are reasonably likely to injure or kill some juvenile salmonids and their prey through a combination lethal and sublethal effects that will continue while the Provolt Seed Orchard IPM is in effect and pesticide use is part of that program.

Because such pesticide releases are likely to injure or kill individuals of these ESA-listed species, incidental take is reasonably certain to occur. However, the relationship between habitat conditions and the distribution and abundance of salmonids in the action area is imprecise, as is the exact type, amount and timing of the pesticides that are likely to be released, such that a specific number of individuals likely to be taken cannot be practically obtained. In these circumstances, NMFS uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take as a numerical level of habitat disturbance.

In this case, the extent of take for this incidental take statement is limited to that which will result from detection of any pesticide concentration in the water column shown by the 'low trigger' and 'high trigger' values presented in Table 15, below. These indicators and their estimated values were selected using the best available scientific information on the effects of acute toxicity on ESA-listed salmon.

The 'low trigger' values refer to concentrations in flowing water that may be exceeded for one compound, one time, during each of the three annual precipitation and application 'zones' as described in this Opinion. Thus, a total of three annual exceedences of the 'low triggers' are allowed, one during each period. The 'high trigger' values are concentrations at which acute lethal take is likely to occur and are the maximum extent of take authorized by this opinion. Any observed concentration of a compound named here that is greater than a 'high trigger' will

exceed the extent of take authorized by this opinion. These 'low trigger' and 'high trigger' values may be revisited annually to incorporate any significant new information regarding baseline conditions and the lethal or sublethal effects of pesticides on salmonids.

Table 15. Extent of Incidental Take Anticipated to Result from Completion of the Provolt Seed Orchard IPM Quantified as Pesticide Concentrations in the Water Column

Compound	Chemical Family	Low Trigger (PPB)	High Trigger (PPB)
Chlorpyrifos	Organo-phosphate	0.15	1.5
Dimethoate		310	3100
Diazinon		4.5	45
Permethrin	Pyrethroids	0.4	3.5
Esfenvalerate		0.0005	0.045
Propargite	Organo-sulfite	5.9	59
Trichloropyridnol (Triclopyr and chlorpyrifos degradate) picloram	Pyridine derivatives	75	750
Chlorothanil	Chlorinated-benzene nitrile	2.1	21

In this Opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species. Moreover, the habitat that will be affected is not unique and does not appear to be limited on a watershed scale or site-specific basis. The extent of habitat affected by the action is the threshold for reinitiating consultation. Should any of these limits be exceeded during project activities, the reinitiation provisions of this Opinion apply.

Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The BLM has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the BLM fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions.

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of listed species resulting from completion of the proposed action.

The BLM Shall:

1. Minimize incidental take by ensuring that orchard pests are managed using IPM techniques that use treatment thresholds and minimize the need for pesticide application.
2. Minimize incidental take from pesticide applications by choosing pesticide formulas, timing, place, and manner of pesticide use to minimize the likelihood of delivery to riparian and aquatic systems.
3. Minimize incidental take from fertilizer application by ensuring that fertilizer is applied in a time, place and manner that minimizes the likelihood of delivery to surface and groundwater.
4. Ensure completion of an annual comprehensive monitoring and operations reporting program to confirm this Opinion is meeting its objective of minimizing take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BLM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary and, in relevant part, apply equally to proposed actions in all categories of activity.

1. To implement Reasonable and Prudent Measure #1 (integrated pest management) the BLM shall:

   a. Treatment Thresholds. Ensure that no action to suppress insect pests will be taken unless pest monitoring show that one or more pests have reached a threshold at which losses in seed yield and quality exceed the economic and environmental cost of treatment. No pesticide will be applied on a routine basis, without regard for treatment thresholds based on pest populations.

   b. Prescribed Burning. When prescribed burning will be used as a pest control, the following conditions will apply.

      i. Design the prescribed burn to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function.

      ii. Ensure that all vehicles, including emergency equipment, are not operated, maintained and stored next to any stream, waterbody or wetland. Equipment shall not disturb native riparian vegetation.

      iii. Ensure that all vehicles, including emergency equipment, are not fueled within 150 feet of any waterbody.

      iv. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to

restore riparian ground cover and vegetation.

v. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.

c. Each supervisor engaged in IPM activities must be informed of the following requirement:

> NOTICE: If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NMFS Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

2. To implement Reasonable and Prudent Measure #2 (use of pesticides), the BLM shall ensure that:

a. Spill Prevention Plan. Prepare and carry out a spill prevention plan to prevent contamination from spill of pesticides and other hazardous materials. The plan will contain the pertinent elements listed below, meet requirements of all applicable laws and regulations, and must be available for inspection on request by NMFS.

i. The name and address of the party(s) responsible for accomplishment of the spill prevention plan.

ii. A description of any regulated pesticide and other hazardous materials that will be used as part of the IPM Plan.

iii. Training and certification for those who will be involved with pesticide transportation, storage, use, disposal, record keeping, monitoring, and emergency response

iv. Practices to prevent spills associated with mixing sites (i.e. containment), critical areas where spills are likely to occur, and environmental restrictions.

v. Spill containment and notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available on the site, proposed methods for disposal of spilled materials.

vi. Identify specific routes of the equipment, load limits for equipment, allowable speeds on the routes, mixing site limits in quantities, chemical types, or spill potential.

b. Choice of pesticide. Choose pesticides and additives as follows:

i. When pesticides are required, the BLM will choose the pesticide that is

least toxic to fish while meeting IPM pest control objectives, and accounting for human health concerns.

ii. No carrier other than water will be used to mix (dilute) the pesticide products for application.

iii. No surfactant or adjuvant that contains ingredients included on EPA's List 1 or 2 for toxicological concern or that has a high priority for testing (EPA 2000a) may be used, unless otherwise approved in writing by NMFS.

iv. Only one application of picloram may be made on an area in any given year to reduce the potential for picloram accumulation in the soil.

v. No additional adjuvants may be added to Rodeo®, including but not limited to 'x-77.'

c. Timing of pesticide application. Time pesticide applications as follows:

i. Prioritize applications for mornings or evenings when pollinators are not active (as seasonally applicable) in accordance with the best overall weather period.

ii. Weather. Pesticides will **not** be applied under the following weather and soil conditions unless the product label specifically recommends otherwise.

(1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. These methods shall be documented and included in the annual monitoring report.

(2) In areas with standing water, saturated soils, snow or ice.

(3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.

(4) In wind that exceeds 6 miles per hour or blows toward flowing streams.

d. Areas of pesticide application.

i. Application buffers. Application methods will be restricted by zones as follows. Zone widths refer distances from any intermittent or perennial stream or waterbody with flowing water, measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration zone, or the edge of any associated wetland, whichever is greater. These buffer widths shall not be decreased over the five-year term of this Opinion.

(1) **<20 Feet**. Cultural methods and hand-held wicks using the Rodeo® formulation of glyphosate. Only small amounts of the product as required to treat the immediate application site may be brought into this zone. In stream reaches where foliar applications of Rodeo® are used to treat knotweed growing in dry portions of the stream channel below the ordinary high water elevation, application will be limited to the dry portions of the stream

channel in the preferred in-water work period, in accordance ODFW guidance.

(2) **>20 Feet.** Cultural methods only, although hand-held wicks and backpack sprayers may be used to control plants designated as noxious weeds in Oregon, as defeined in ORS 603-52-1200, that cannot be effectively controlled using cultural methods.

(4) **>40 Feet.** All of the above, and hydraulic sprayers with handheld wands, capsule implants, and tractor pulled spray rigs with booms

(5) **>90 Feet.** All of the above, and high pressure hydraulic sprayer.

ii. Do not apply pesticides to road or ditch surfaces that directly contribute to stream channel flow, nor to fence-lines within 50 feet on either side of stream channels.

iii. Install silt catchments barriers, such as bio-bags, across all ephemeral drainages beside or inside treatment units when overland flow may occur following pesticide application.

e. Method of pesticide application.

i. Mow or graze orchard fields before insecticide applications to remove floral components or ground cover that attract pollinators (as seasonally applicable and practicable).

ii. No pesticide may be applied on a routine basis, without regard for treatment thresholds based on pest populations.

3. To implement Reasonable and Prudent Measure #3 (use of fertilizers), the BLM shall ensure that:

a. Fertilizer will not be applied within 50 feet of any stream, wetland or other waterbody.

b. Fertilizer will be applied at agronomic rates.

c. Fertilizer loading (pertaining to application equipment) areas shall be at least 100 feet from perennial streams.

4. To implement Reasonable and Prudent Measure #4 (monitoring and reporting), the BLM shall ensure that:

a. Annual monitoring report. All water quality monitoring information associated with application of the Provolt Seed Orchard IPM program shall be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' shall include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, shall be contained in an Annual Provolt Seed Orchard Monitoring Report. This report shall be available to the public and regulatory agencies on November 15 of each year and be on file at the Provolt seed orchard. This report shall include the following information:

i. Project Identification.
   (1) BLM contact person.
   (2) Pesticide project manager.
   (3) Starting and ending dates for work completed.

ii. IPM Documentation.
   (1) Description of how treatments were based on weather and pest monitoring.
   (2) A description of the biological and cultural pest controls used before pesticides were applied, or the reasons that biological and cultural controls were not used. Note that this provision is applicable to initial decisions to apply pesticides in response to pest population levels, not each individual application, and shall be documented within the annual monitoring report.

iii. Pesticide Use History.
   (1) Type of chemical applied.
   (2) Date of application.
   (3) Buffers present.
   (4) Method of pesticide application.
   (5) Total area treated.
   (6) Amount of pesticide applied.
   (7) Precipitation for the three days preceding and following application.
   (8) Wind direction and speed, relative humidity, air temperature at time of application.
   (9) Location used for mixing and loading and notes regarding whether any leakage or spills occurred.

iv. Effectiveness Monitoring.
   (1) Orchard units or treatment areas directly beside open water (within 100 feet) shall require drift cards be placed at a maximum of 100-foot intervals along the edge of Provolt's unit before the application (for high-pressure hydraulic sprayer applications).
   (2) If open canopy occurs in the waterway buffer, drift cards shall be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Any applications shall cease if there is any indication that there is off-target delivery occurring.

v. Surface Water Monitoring to Detect Drift.
   (1) For high-pressure hydraulic sprayer applications of chemicals, water samples shall be collected before and after spray application that include representative '15 minute' and 24-hour (composite)' post treatment water samples.

(2) Surface water samples are collected within the project area, also, where appropriate, collect water samples concurrently where flowing water enters the project area to facilitate a baseline/cumulative concentration analysis.

Surface drift monitoring shall occur for the following compounds that are applied using the specific methodologies.

Application Method	**Compound**	**Surface Water Drift Monitoring**	**Sites for Surface Water Drift Sampling**	**Sites for SPMD Placement**
High pressure hydraulic sprayer	Esfenvalerate Chlorpyrifos Permethrin Diazinon Dimethoate Propargite Chlorothalonil	A representative stream or streams will be sampled and tested for each application	Beside Williams Creek. Units 1, 5, 7, 9a, 17	Williams Creek above 9a and below 1 and 17 for 1, 5, 7, 9a
			Beside Irrigation ditches 1, 5, 7, 9b, 12, 14, 15, 16	Bridgeport Ditch NW corner of 7 and SE corner of 14 for 5, 7, 9b, 12, 14 Laurel Hill Ditch NW corner of 15 and above 1 for 1, 15, 16.
Hydraulic sprayer w/ handheld wand	Esfenvalerate	Surface water sampling and testing for each application within 300 feet of surface water	Same as above	
Backpack Sprayer - Hand-held wand	Esfenvalerate	Surface water sampling and testing for each application within 100 feet of surface water		

Note: For Orchard Unit numbers referenced above, see page76-78of the Provolt Biological Assessment.

vi. Cumulative Concentrations Runoff.

(1) Stormflow with the highest potential for chemical presence shall be sampled and, during these flow events, samples shall be composited according to the rise and fall of the hydrograph.

(2) SPMDs shall be deployed to sample initial winter storms and spring storm periods after pesticide application.

(3) The SPMDs shall be tested for those pesticides that were applied that can be accurately sequestered.

(4) SPMDs will be strategically deployed in timeframes that are representive of potential exposure scenarios, such as runoff from

significant rain events and or drift during application. SPMDs shall be deployed for approximately 30 days, though smaller time increments are encouraged because they are more sensitive to pulses of pesticides.

Provolt monitoring locations for runoff and SPMD placement shall be at the following sites.

Sites related to surface runoff	**Sites related to SPMD placement**	**Sites related to tile monitoring**
Section 23; (site 9c) Ph-2, beside I-33 I-33 B-51 P-32	Section 23, above and below the SPMD B-51 I-33 Ph-2 beside I-33	 B-12 B-14 (tile site 3) I-33 I-10 (tile site 2) Control (tile site 1)
Section 23; (site 11a) I-12 I-11 I-33 Ph-2 I-10	Section 13 SPMD: Stream 5 and 2. B-30, B-11, B-50, B-15, B-12, B-14	

Note: For Orchard Unit numbers referenced above, see page 85 and 86 of the Provolt Biological Assessment.

vii. Validation Monitoring. For select sites, monitoring shall be used to validate the water quality modeling predictions presented in the EIS and BA.

(1) Concentrations shall be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.

(2) If detectable concentrations are found, stream concentrations shall also be compared to model results using actual application information, field-specific data, and continuous climate record. These data shall provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.

viii. Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, shall be immediately evaluated to determine if water sampling is desirable and necessary. If the spill occurs in an area that is reasonably certain to deliver to surface waters, either immediately, or on the next precipitation event, sampling shall occur, as appropriate.

(1) Water samples shall be collected in a sufficient number and at surface water and groundwater locations that shall allow characterization of impacts and effective remediation methods. Depending on ODEQ Monitoring Hazardous Substances Remediation Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil.

ix. Groundwater Monitoring. The domestic well at Provolt shall be monitored for groundwater contamination. These samples shall occur annually, and normally be collected in late summer and handled according to state-certified laboratory instructions.

(1) Groundwater monitoring wells associated with the greenhouse effluent field shall be monitored. Water quality sampling shall be conducted when risks are highest for irrigation water to potentially reach the local groundwater table. If 'point in time' samples are found to have detectible levels of the pesticide, SPMDs shall also be deployed in selected wells to allow a more quantitative determination of concentration over time.

(2) Notification of Discharge. If a surface water discharge occurs, the BLM shall notify NMFS within 10 business days of detection. Notification shall include the type, location, and concentration of the discharge.

x. Circumstances that would trigger reinitiation:

(1) More than one discharge per zone, as defined in this Opinion, between the 'low trigger' and 'high trigger'; values (within any one year). Note that discharges below the low trigger value are not applicable to this total.

(2) A discharge within any one year above the 'high trigger' value.

(3) For compounds with a common mode of action (i.e. pyrethroids and organophosphates), if the sum total of the toxic units is >0.05 (equivalent to $1/20^{th}$ of the standardized LC50s) it will be counted as a 'low trigger' exceedence. If the sum total of the toxic units is > 0.5 (equivalent to ½ of the standardized LC50s) it will be counted as a 'high trigger' exceedence. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column). The toxic units for each class, pyrethroids, and organophosphates, will be calculated as outlined within this Opinion. Only one 'low trigger' exceedence will be counted if there is a toxic unit 'low trigger' exceedence for a particular chemical family that contains a 'low trigger' exceedence of an individual compound within that same chemical family.

(4) To account for the synergistic action of pyrethroids and organophosphates, as described within this Opinion, an exceedence of a 'low trigger' of both a pyrethroid and an

organophosphate (either individually or as a sum total of family toxic units) will be considered the equivalent of exceeding a high trigger. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column), and includes SPMD data.

(5) Upon any SPMD detection, the data shall be used to provide a 24-hour average waterborne contaminant concentration for the chemicals that were applied and can be sequestered. To reflect the margin of error within the SPMD methodology, a two-fold safety factor (Huckins 2004) shall be applied to the back calculated 24-hour average concentration (multiply the value by two). The corrected 24-hour concentration shall then be treated as a discharge within the final monitoring plan and the same circumstances apply for reinitiation.

(6) An annual review of SPMD data collection, data use, and sampling methodology may occur. In the event of a detection, factors leading to the resultant discharge concentration shall be reviewed.

c. Annual Operation Report. The Annual Operation Report will be submitted to NMFS by December 1st, and include the following information (NMFS will review the Annual Operation Report within 30 business days of its receipt, note that the annual operations plan for 2005 only needs to include data specified within number (5)):

i. The results of the previous year monitoring program. If a discharge occurred during the previous year, possible causes of the discharge shall be explored, as well as future mitigation steps to prevent like discharges in the future.

ii. A data review of the pesticides that are proposed for use, or may be used, at Provolt in the following year. The review shall include:

(1) New scientific data regarding non-target fish species effects or environmental fate.

(2) Changes to EPA-approved labels (ESA-approved and other).

(3) A review of legal findings relevant to the use of pesticides.

(4) A plan for proposed pesticide applications for the following year, including, to the extent possible, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored.

(5) Any proposed changes to the IPM, including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those proposed; or other relevant information.

(6) The annual report shall be sent to:

Director, Oregon State Habitat Office
NMFS
Attn: 2004/00207
525 NE Oregon Street
Portland, OR 97232

d. Annual Coordination. Meet with NMFS by March 31 each year to discuss the annual monitoring report and any action necessary to make the program more effective.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).
- NMFS must provide conservation recommendations for any Federal or state action that would adversely affect EFH (§305(b)(4)(A)).
- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (50 C.F.R. 600.10). 'Adverse effect' means any impact which reduces quality and/or quantity of EFH, and may include direct (*i.e.*, contamination or physical disruption), indirect (*i.e.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810).

EFH consultation with NMFS is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

Identification of EFH

The Pacific Fishery Management Council designated EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream from certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the *Pacific Coast Salmon Plan* (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

Proposed Actions

The proposed action and action area are detailed above. The action area includes habitats that have been designated as EFH for various life-history stages of Chinook and coho salmon.

Effects of Proposed Action

As described in detail above, the proposed action may result in short- and long-term adverse effects to habitat due to adverse alteration of water quality.

Conclusion

NMFS concludes that the proposed action may adversely affect designated EFH for Chinook and coho salmon.

EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. The terms and conditions outlined in this Opinion are generally applicable to designated EFH for Chinook and coho salmon and address these adverse effects with the exception of monitoring requirements (RPM 4). Consequently, NMFS adopts Terms and Conditions 1 through 3 as EFH conservation recommendations.

Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR 600.920(j), Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

Supplemental Consultation

The BLM must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 C.F.R. 600.920(k)).

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law106-554) ('Data Quality Act') specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: This ESA section 7 consultation on the proposed programmatic IPM program at the Provolt Seed Orchard in Jackson and Josephine Counties, Oregon concluded that the action will not jeopardize the continued existence of SONC coho salmon. Pursuant to the MSA, NMFS provided the BLM with conservation recommendations to conserve EFH. The intended user of this consultation is the BLM. The American public will benefit from the consultation.

This consultation will be posted on the NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in

Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 C.F.R. 402.01 *et seq*., and the MSA implementing regulations regarding EFH, 50 C.F.R. 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No.:
2004/00206

February 9, 2005

Mr. Timothy B. Reuwsaat
District Manager
Medford District Office
Bureau of Land Management
3040 Biddle Road
Medford, Oregon 97504

Re: Amendment to the Endangered Species Act Interagency Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Proposed Integrated Pest Management Program at the Charles A. Sprague Seed Orchard in Josephine County, Oregon

Dear Mr. Reuwsaat:

On January 18, 2005, the National Marine Fisheries Service (NMFS) transmitted our biological opinion and Magnuson-Stevens Fishery Conservation and Management Act (MSA) essential fish habitat (EFH) consultation on the effects of the Bureau of Land Management's (BLM) actions to carry out the Proposed Integrated Pest Management Program at the Charles A. Sprague Seed Orchard in Josephine County, Oregon (Opinion) (refer to: NMFS No.: 2004/00206). That Opinion was one of four issued at approximately the same time as a result of concurrent consultations on different seed orchards in Oregon, all operated by the BLM. Since then, staff of NMFS and the BLM reviewed the results of those four consultations and found drafting errors were made such that some actions were attributed to the wrong orchard and, consequently, resulted in an improper effects analysis and incidental take statement. The enclosed document contains an amended Opinion intended to correct errors in the January 18, 2005 document, which is now withdrawn, and ensure that we have a common understanding of our consultation efforts.

In this new Opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of the Southern Oregon/Northern California coho salmon (*Oncorhynchus kisutch*), listed as threatened under the ESA. This Opinion also includes an amended incidental take statement with terms and conditions necessary to minimize the impact of the taking that is reasonably certain to be caused by this action. Take from actions by the action agency and contractors, if any, that meet these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of our amended consultation on the action's likely effects on essential fish habitats (EFH) for Chinook (*O. tshawytscha*) and coho salmon pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes three conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects to EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations. If the response is inconsistent with the recommendations, the BLM must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

I apologize for any inconvenience these errors may have caused and appreciate the interest you and your staff has in assuring that our consultations are based on the most accurate and up-to-date information available. If you have further questions, please do not hesitate to contact Dan Gambetta, fisheries biologist, at 503.231.2243, or Ken Phippen, Southwest Oregon Habitat Branch Chief, at 541.957.3385.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: Bob Ruediger, BLM
Jeannette Griese, BLM

Amendment to the Endangered Species Act - Section 7 Consultation Biological Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

Proposed Integrated Pest Management Program,
Charles A. Sprague Seed Orchard,
Josephine County, Oregon

Agency: Bureau of Land Management

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Date Issued: February 9, 2005

Issued by: for Michael R Crouse

D. Robert Lohn
Regional Administrator

Refer to NMFSNo.: 2004/00206

Acronyms used in this document:

AgDrift - Agricultural Drift
BLM - Bureau of Land Management
BMPs - Best Management Practices
BRT - Biological Review Team
Bt - *Bacillus thuringiensis*
CFS - Cubic Feet Per Second
CPs - Conservation Practices
DOI - Department of Interior
EC - Effective Concentration
EIS - Environment Impact Statement
EFH - Essential Fish Habitat
EPA - Environmental Protection Agency
ESA - Endangered Species Act
ESUs - Evolutionarily Significant Units
EXAM - Exposure Analyis Modeling Systems
FMPs - Federal Fishery Management Plans
GLEAMS - Groundwater Loading Effects of Agricultural Management Systems
IPM - Integrated Pest Management
LC50 - Median Lethal Concentration
LOEC - Lowest Observed Effect Concentration
MSA - Magnuson-Stevens Fishery Conservation and Management Act
mg/L - milligrams per liter
MPI - Matrix of Pathways and Indicators
MOC - Method of Characteristics
NOAA Fisheries - NOAA's National Marine Fisheries Service
NWFSC - Northwest Fisheries Science Center
ODEQ - Oregon Department of Environmental Quality
ODFW - Oregon Department of Fish and Wildlife
ODF - Oregon Department of Forestry
OSUES - Oregon State University Extension Service
PFMC - Pacific Fishery Management Council
PPM - Parts Per Million
PFC - Properly Function Condition
RA - Risk Assessment
RM - River Mile
ROD - Record of Decision
SERA - Syracuse Environmental Research Associates
SONC - Southern Oregon/Northern California
SPMDs - Semi-Permeable Membrane Devices
SWW - Southwest Washington
USDA - United States Department of Agriculture
USGS - United States Geological Survey
VSP - Viable Salmonid Population
WTC - Washington Toxics Coalition

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INTRODUCTION

The Bureau of Land Management (BLM) owns and operates the 200-acre Charles A. Sprague (Sprague) seed orchard near Jump-off Joe Creek and the Rogue River in Josephine County in southern Oregon. The BLM operates Sprague to produce conifer seedling production, preserve individual conifer trees, and produce native species seed. The purpose of the proposed action is to manage competing and unwanted vegetation, diseases, insects, and animal pests at Sprague. Proposed management consists of biological, chemical, cultural, and other methods to preserve and enhance seed orchard production. Collectively, these actions are referred to as integrated pest management (IPM).

Federal agencies are required under section 7(a)(2) of the ESA to consult with the National Marine Fisheries Service (NMFS) on their actions that authorize, fund or carry out activities that 'may affect' ESA-listed salmonids or designated critical habitat. From a scientific perspective, among the diverse actions that 'may affect' listed fish in the Northwest Region, pesticide and herbicide applications can be among the most complex. Many rivers and estuaries in the Pacific Northwest are contaminated with toxic chemicals. Water and sediment pollution can degrade fish habitat and impair the fitness of salmon and marine fish species. While there is a healthy volume of literature regarding some pesticide and herbicide effects to aquatic species, in some cases, data for a specific pesticide/herbicide on particular salmonid species and their prey, including their diverse life-stages, is lacking. To address this, a number of scientific agencies, including the Environmental Protection Agency (EPA), the NMFS Northwest Fisheries Science Center (NWFSC), and various universities are continuing to conduct and publish studies that further describe pesticide and herbicide effects to aquatic species. Research within the NWFSC, particularly the Ecotoxicology and Environmental Fish Health Program,[1] is focused on contaminants that interfere with the normal function of the fish nervous system, and may therefore impair the survival or reproductive success of exposed fish. The NWFSC is continuing to develop new methods to detect developmental abnormalities in fish that have been exposed to common environmental chemicals.

On January 22, 2004, the U.S. District Court for the Western District of Washington ruled in the case of *Washington Toxics Coalition (WTC) v. EPA*. For ground pesticide applications, the court issued an order that establishes a 20-yard buffer zone. For aerial pesticide applications, the court order establishes a 100-yard buffer zone. These buffers are applicable beside salmon-supporting waters around certain waterbodies in California, Oregon, and Washington, to which specific pesticides cannot be applied.

Chief Judge Coughenour issued this order in response to the WTC's July 16, 2003, motion for injunctive relief to establish buffer zones as an interim measure to reduce the likelihood of jeopardy to 26 species of salmon and steelhead. This order is in effect until the EPA and NMFS have completed an evaluation of threatened and endangered Pacific salmon and steelhead and

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[1] http://www.nwfsc.noaa.gov/research/divisions/ec/ecotox/index.cfm

their critical habitats to exposure from 55 pesticides. Under the ESA, EPA must ensure that its registration of a pesticide is not likely to jeopardize the continued existence of species listed as endangered and threatened or adversely modify habitat critical to those species' survival. In addition to the obligation to ensure that its actions are not likely to jeopardize listed species, the EPA must consult, as appropriate, with the U.S. Fish and Wildlife Service (USFWS) or NMFS if a pesticide's use may affect listed species or designated critical habitat.

Background and Consultation History

This five-year consultation for Sprague was initiated by the BLM to help streamline the implementation of a comprehensive IPM program. For the past two years, the BLM and NMFS have conducted coordination meetings and correspondence to review and refine the proposed action, review draft versions of the biological assessment (BA), the Risk Assessment (RA) and the draft Environment Impact Statement (EIS). Pre-consultation coordination is summarized below. Most of the listed meetings also discussed the other seed orchards that were intended to undergo separate consultation with NMFS. The other seed orchards are Horning, Provolt, and Tyrrell, all in Oregon. The proposed IPM programs for all the seed orchards are generally similar.

- On October 29, 2002, BLM and NMFS staff toured the Sprague site.
- On July 10, 2003, NMFS and the BLM held a conference call to discuss the draft EIS and information necessary for the BA.
- On August 5, 2003, NMFS and BLM staff met to discuss structuring the BA and biological opinion (Opinion) to facilitate multi-year consultation, among other topics.
- On August 13, 2003, NMFS sent a letter to the BLM with comments on the draft EIS and in anticipation of future section 7(a)(2) consultation for Sprague.
- On November 11, 2003, NMFS sent comments through electronic mail on the draft BA.

In addition to the above, many phone calls and e-mails were exchanged between NMFS and the BLM regarding the proposed action. The BLM, at the request of NMFS, tailored their assessment of the IPM with technical guidance drafted by the NWFSC for NMFS section 7 pesticide and herbicide consultations. The BLM provided several versions of the draft BA, risk analysis, and monitoring plans for NMFS' review and comment. In addition, the BLM reviewed draft versions of the proposed action and reasonable and prudent measures within this Opinion. Correspondence related to this consultation is available within the administrative record, at NMFS' Oregon State Habitat Office in Portland, Oregon.

NMFS received a letter dated March 2, 2003, and an accompanying BA from the BLM requesting informal consultation on the proposed five-year IPM program for the Sprague orchard. In the letter and the BA, the BLM determined that the proposed action is 'not likely to adversely affect' (NLAA) Southern Oregon/Northern California (SONC) coho salmon (*Oncorhynchus kisutch*). In March 2004, NMFS informed the BLM the proposed IPM program was 'likely to adversely affect' (LAA) SONC coho salmon, and recommended formal consultation for the proposed action.

This consultation also fulfills the essential fish habitat (EFH) consultation requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) 1996. The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NMFS on all actions or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)). The objective of the EFH consultation is to determine whether the proposed action will adversely affect designated EFH for Chinook (*O. tshawytscha*) and coho salmon, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

This Opinion was originally issued on January 18, 2005 and is currently being amended at the Agency's request in order to clarify the proposed action. This amendment shall supercede the previous Opinion in its entirety.

The action area for this consultation includes the areas of Jump-off Joe Creek below Sprague, and the Rogue River for several miles after its confluence with Jump-off Joe Creek.

Description of the Proposed Actions

Management of pests enables the seed orchard to produce improved seed for conifer seedling production, preserve valuable individual conifer trees, produce native species plants and plant species seed, and produce containerized seedlings in a greenhouse nursery. This seed is supplied to BLM and other cooperators for reforestation and restoration projects.

The pest management objectives at Sprague include the following:

1. Minimize insect damage to orchard trees, cone crops, and native plants.
2. Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
3. Reduce growth of vegetation to allow tree establishment and growth, and reduce the fire hazard.
4. Treat fungal and bacterial diseases to maintain the health and vigor of the orchard trees used for seed production and control plant pathogens in native seedling grow-out beds.
5. Minimize animal damage to orchard trees, orchard equipment and infrastructure.

The BA states that it is the policy of the Department of Interior (DOI) to use chemical pesticides only after considering all the alternatives, and to develop, support, and adopt IPM strategies wherever practicable (DOI 1981). The definition of IPM used in the BA is as follows:

> IPM is an approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops, harming animals, infesting buildings or otherwise interfering with our livelihood or enjoyment of life. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to

control pests only when their numbers are likely to exceed acceptable levels. Any action taken is designed to target the troublesome pest, and limit the impact on other organisms and the environment. Applying pesticides to crops, animals, buildings or landscapes on a routine basis, regardless of need, is not IPM.

The BA further defines the context for the proposed Sprague IPM, emphasizing the holistic approach to pest management consistent with DOI policy, and the integration of a broad range of pest control methods:

> IPM for seed orchards is the maintenance of seed orchard pests at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory methods (including no action) that are consistent with orchard management goals. Each pest management activity is the end result of a decision-making process where pest problems and their impact on hosts are considered, and control methods are analyzed for their effectiveness, as well as their impacts on economics, human health, and the environment. Deciding which particular method would be used depends on several factors. Initial questions at the seed orchard might include, "Is it really necessary to control this pest? Can we live with the damage and still have the trees survive and produce suitable amounts of seed?" If the answers are yes and no, respectively, then decisions must be made as to what method(s) of control to use.
>
> The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed (BLM 2004).

The BLM has proposed a number of specific measures to address unwanted vegetation, insects, disease, and animal pests at Sprague. These measures generally fall into the following categories:

1. Biological controls, such as bird or bat boxes to attract insect-eaters, or encouraging predators that can control animal pests.
2. Prescribed burning to remove vegetation.
3. Cultural methods, including mechanical (tractor mowing) and manual (pruning) methods, mulch mats, and fences.
4. Chemical insecticides, herbicides, fungicides and fertilizers.

Biological Controls

Biological pest control is the deliberate use of natural enemies such as parasites, predators, or disease organisms to reduce pest populations. Three types of biological control are in use or proposed for use to manage insect pests:

1. Bird boxes have been installed throughout Sprague to attract cavity-nesting birds into Sprague to nest and feed.
2. Bat houses have also been placed throughout Sprague to provide roosting and breeding habitat to encourage bats, such as the big brown bat and little brown myotis, to live in the vicinity and feed on insects in Sprague.
3. *Bacillus thuringiensis* (Bt), is being considered to help reduce insect damage at Sprague.

Prescribed Burning

The BLM proposed annual controlled broadcast burning to control one to two acres of vegetation along fence lines, roadsides, and irrigation ditches during the winter and early spring months. Once or twice each year (spring or early winter), one or two piles are planned to be burned by BLM fire specialists.

Pile burning of insect-infested vegetation or cones once or twice per year will reduce insect populations by eliminating the habitat, which would otherwise allow the pupae to emerge in spring as adult insects. Pile-burning of vegetation with disease infections is a sanitation method of control, which eliminates the infected material and reduces the risk of spread within Sprague.

In addition, prescribed fire could be used for removing vegetation in native species beds before planting. High temperatures, created through the use of a propane-fueled flame wand, kill any existing herbaceous material, provide a weed-free bed for growing native plants, and removing dead plant litter. Prescribed fire may also be used to remove native grass straw after seed harvest or diseased native grasses in native species beds. Prescribed fire is not proposed for use in riparian areas.

Cultural Methods

The following methods may be used for various applications:

1. Vegetation. Hand-pulling, pruning, thinning, hand tools to cut and grub, tractors with various blade attachments for mowing, gasoline-powered string trimmers, brush cutter machine mounted on tractor, chainsaw for cutting up thinned, rogued, dead/dying orchard trees, power pruner, wood chipper, chipping with large tub grinders and marketing the chips for energy development, and mulch mats.
2. Disease. Pruning, power saws to cut infected or dead trees, removal of diseased plants from the native plant gardens using a tractor and rototiller, mesh shade screens to protect seedlings from heat damage, hand-painting older trees with exposed and thin bark to reflect the sun's rays and insulate from extreme heat.
3. Animal pests. Trapping of gophers, porcupines, and other small mammals, fencing that excludes deer and elk from the orchard, Vexar™ tubes to protect seedlings, use of sticky traps in greenhouses, screening to exclude squirrels from seed extractory and cone shed.

4. Insects. Pruning, thinning, shaping, use of grafting wax or spray seal on tree wounds, sanitation of damaged branches and trees, sanitation of insect-damaged cones and cones not harvested for seed production, hand-picking large and noticeable insect pupae.

Chemical Pesticides (insecticides, herbicides, fungicides and fertilizers)

Table 1 lists the following chemical pesticides available for use at Sprague.

Table 1. Pesticides Proposed for Sprague

Insecticides	Fungicides	Herbicides	Fertilizers
-acephate -chlorpyrifos -diazinon -dimethoate -esfenvalerate -horticultural oil -imidacloprid -permethrin -potassium salts of fatty acids (Safer® Soap) -propargite (miticide)	-chlorothalonil	-dicamba -glyphosate -picloram	-ammonium nitrate -ammonium sulfate -ammonium phosphate -calcium nitrate -potassium nitrate

Table 2 provides the relative toxicity to salmonids and insects, and application data as proposed by the BLM.

Table 2. Pesticide, Herbicide and Fertilizer Data

Pesticide	Chemical Family	Pest. Use	Fish Acute Toxicity	Application Date Range	Application Frequency	Application Method
Acephate	Organo-phosphate	I	Slightly toxic	Mar-Jul	Every 1 to 3 Years	Implants
B.t.	Biological	I	No Data Available	Mar-Jul	Annually	HPHS or HSHHW
Chlorpyrifos	Organo-phosphate	I	Very highly toxic	May-Sep	1 to 2X in a 10 year period	HPHS or HSHHW
Diazinon	Organo-phosphate	I	Very highly toxic	Apr-Sep	1 to 2X in a 5 year period	HPHS or HSHHW
Dimethoate	Organo-phosphate	I	Slightly to moderately toxic	Apr-Sep	1 to 2 times in a 5-year period	HSHHW or BS
Esfenvalerate	Pyrethroid	I	Very highly toxic	May-Jul	Every 2-3 years	HPHS -or- HSHHW -or- BS
Horticultural Oil	Petro-Chem	I	Moderate to highly toxic	Mar - Sep (as additive) Sep - May (dormant oil)	Every 1 to 2 years as an alt or supplement to non-chemical treatment	HPHS HSHHW or BS
Permethrin	Pyrethroid	I	Very highly toxic	May-Jul	As back up or alternative to esfenvalerate	HPHS HSHHW or BS
Potassium Salts of Fatty Acids	Fatty Acids	I,F,H	Slightly toxic	Mar-Sep	Every 1 to 2 years as an alt or supplement to non-chemical treatment	HPHS or HSHHW or BS
Propargite	Organosulfite	I	Highly Toxic	Apr-Oct	1 to 2X in a 10-year period	HPHS or HSHHW or BS
Chlorothalonil	Chlorinated benzene nitrile	F	Very Highly Toxic	Feb-Jun	1 to 2X in a 5 year period	HPHS

Pesticide	Chemical Family	Pest. Use	Fish Acute Toxicity	Application Date Range	Application Frequency	Application Method
Dicamba	Benzoic acid derivative	H	Slightly toxic	Apr-Jun	Back up or Alt. to glyphosate or for persistent weeds	HSHHW or BS
				Apr-Jul		Tractor-pulled spray rig w/ boom
				Apr-Jul		HHW
Glyphosates (roundup)	Amino acid derivative	H	Moderately toxic	Apr -Aug	Initially 2 to 3X per year, as plant pop. diminish, then 1 per year	Tractor-pulled spray rig w/ boom
						HSHHW or BS
Glyphosate (rodeo)	Amino acid derivative	H	Moderately toxic			HHW
Picloram	Picolinic acid derivative	H	Slightly to moderately toxic	Apr-Jun	1 to 2X in a 10-year period	HSHHW -or- BS
Triclopyr	Amine salt	H	Slightly to moderately toxic	Apr-Jun	1 to 2X in a 10-year period	HSHHW or BS

Relative fish toxicity as determined by the Pesticide Action Network (PAN)[2]

KEY:
I = insecticide, F = fungicide, H = herbicide
HSHHW=Hydraulic Sprayer with Hand Held Wand, BS=Backpack Sprayer, HPHS=High Pressure Hydraulic Sprayer, HS=Hand Sprayer

Proposed Conservation Practices (CPs)

1. Pesticides would be applied within the parameters of prescribed environmental conditions stated on the label.
2. No spraying would occur if snow or ice covers the target foliage.
3. Temperatures shall be monitored carefully.
4. If possible, spraying would be conducted during the early morning or late evening, allowing foliage to dry before pollinators become active.
5. Orchard fields would be mowed before insecticide applications, to remove floral components on ground cover that would attract pollinators, such as bees (if pollinators are active).

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[2] PAN can be accessed at: http://www.pesticideinfo.org/Index.html

6. Chemical weed control within 20 feet of perennial and non-perennial streams with flowing water at the time of application will be limited to spot hand applications. In stream reaches where foliar applications of Rodeo® are used to treat knotweed growing in dry portions of the stream channel below the ordinary high water elevation, application is limited to the dry portions of the stream channel in the preferred in-water work period, in accordance with ODFW guidance.
7. No carrier other than water will be used to mix (dilute) the pesticide products for application. In some cases, surfactants or adjuvants may be added to application mixtures of pesticides to improve their effectiveness or minimize handling and application problems. The seed orchard will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000a). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical will be evaluated before a use determination is made.
8. Maintenance and calibration of spray equipment will occur at least annually to ensure proper application rates.
9. No more than one application of picloram will be made on an area in any given year to reduce the potential for picloram accumulation in the soil.
10. Permethrin and esfenvalerate will not be used in the same year.
11. Only one application method for permethrin or esfenvalerate will be used in a year.

Proposed Runoff CPs

1. Applications will be timed, to the extent predictable by weather forecasts, to not coincide or closely precede a large storm event that could result in substantial runoff.
2. Silt catchments barriers, such as bio-bags, will be installed across all ephemeral drainages beside or inside treatment units during periods when overland flow may occur following pesticide application. The function of these barriers will be to catch organics and sediment leaving the treatment area.

Proposed Spill CPs

1. Equipment used for pesticide transport, mixing, and application will be properly maintained to avoid leaking pesticides into water or soil.
2. Pesticides will be mixed and equipment cleaned in areas protected (*i.e.*, paved and bermed, or on a portable bermed mixing pad) from the potential for runoff to surface waters or leaching to groundwater in the case of a spill.

Proposed Drift CPs

1. Factors such as relative humidity, wind speed, and air temperature shall be considered to determine the timing of applications that will minimize the potential for off-target drift.
2. Drift cards would be used to indicate when spray is heading toward a riparian zone, and spraying would cease if this danger seems likely.

3. When spraying trees within two tree rows from the edge of treatment unit perimeters, spraying will be done by directing the nozzle towards the center of the treatment unit, minimizing the chance for drift outside the designated treatment areas.

Proposed Application Methods. Pesticides may be applied using several methods, including: (1) High-pressure hydraulic sprayer; (2) hydraulic sprayer with hand-held wand; (3) tractor-pulled spray rig with boom; (4) backpack sprayer; (5) hand-held wick; (6) capsule implantation; and (7) broadcast spreader. For some pesticides, different combinations of pesticide and application method are being proposed to give Sprague flexibility in addressing specific management needs that may occur.

Each method is described briefly in the following paragraphs.

High-Pressure Hydraulic Sprayer. High-pressure hydraulic sprayers consist of a powered pump and tank carried by truck or tractor, and hand-held nozzles for dispersing the solution upward into the tree. These sprayers could be used to treat individual mature trees with the insecticides chlorpyrifos, diazinon, esfenvalerate, permethrin, horticultural oil, or propargite; or with the fungicide chlorothalonil.

Hydraulic Sprayer with Hand-Held Wand. A spray tank is mounted on a truck, tractor, or all-terrain vehicle (ATV), and may be used to apply herbicides around trees in orchard units, along fence-lines, and as a spot treatment in fallow fields, orchard units, and administrative areas. The sprayer may be operated by one worker, who drives and stops to spray, or by two workers, with one driving and the other spraying. This method may be used to apply the insecticides chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, or propargite; the fungicide chlorothalonil; or the herbicides dicamba, glyphosate, or picloram.

Tractor-Pulled Spray Rig with Boom. This method may be used to apply herbicides for control of weeds in orchard units, in roadways, or in fallow areas. Equipment consists of a hydraulic spray tank pulled by a tractor or heavy-duty pickup truck, with a spray boom attached to the tank to release the herbicide. At Sprague, this method may be used to apply the herbicides glyphosate or dicamba.

Backpack Sprayer. A backpack sprayer consists of a plastic tank containing the pesticide that is strapped to the applicator's back. A hand-operated hydraulic pump forces the liquid from the tank through a nozzle in a hand-held wand. At Sprague, a backpack sprayer could be used to apply the insecticides dimethoate, esfenvalerate, permethrin, or propargite; or herbicides dicamba, glyphosate, or picloram, for treatment of unwanted vegetation in orchard units and along fence-lines.

Hand-Held Wick. A hand-held wick consists of a stick containing diluted herbicide in contact with an absorbent material (a rope or wick pad), which is then wiped directly on the foliage of target vegetation. At Sprague, this method may be used to apply dicamba or glyphosate for spot treatment of weeds.

Capsule Implantation. The insecticides acephate and imidacloprid may be implanted into individual trees for long-term control of insect pests in the form of a capsule. One small hole is drilled into a tree for every 4 inches of circumference, and a capsule is inserted.

Broadcast Spreader. Fertilizers may be distributed over the ground using a spreader pulled by a truck, or mounted on a tractor or ATV. Broadcast or sidecast spreaders will be used for general fertilizer (nitrogen/phosphorus/sulfate) applications. Sidecast or drop spreaders will be used to apply calcium nitrate to the dripline of trees for stimulating flower production.

Rate/Frequency/Volume and Locations of Applications. The BLM provided application data for each pesticide proposed for use at Sprague over the proposed five-year term of the consultation. Table 2, below, details the data for diazinon, dimethoate and esfenvalerate application, and is included here as an example of data provided for all pesticides in the BA. All of the tables can be viewed within the BA.

Table 2. Pesticides Application Data - Sprague

Application Method	Location	Typical Application Rate and Area	Max. Label Application Rate and Max. Area	Application Date Range	Anticipated Frequency
Diazinon: Diazinon 50W (50% a.i. as a wettable powder) *Target pests: ants, spiders, moths, aphids, mites, or other serious insect outbreaks in the administrative and landscaping areas, or in isolated orchard locations when small but serious insect damage needs attention*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Individual trees in any production orchard unit	0.015 lb a.i./tree, in water at 3 gal/tree 1 application to 100 trees on 20 acres	0.075 lb a.i./tree, in water at 5 gal/tree 1 application to 300 trees on 20 acres and an additional application to 150 trees on 10 acres	Apr - Sept	Seldom: 1 to 2 times in a 5-year period
Dimethoate: Digon 400 (43.5% a.i. as a liquid concentrate) *Target pests: Douglas-fire cone gall midge*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard unit	0.13 lb a.i./tree, in water at 2 gal/tree 1 application to 500 trees	0.34 lb a.i./tree, in water at 4 gal/tree 2 applications to 500 trees	Apr - Sept	1 to 2 times in a 5-year period

Application Method	Location	Typical Application Rate and Area	Max. Label Application Rate and Max. Area	Application Date Range	Anticipated Frequency
Esfenvalerate: Asana® XL (8.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir cone worm, western conifer seed bug, Douglas-fir seed chalcid, Douglas-fir cone moth, Douglas-fir cone gall midge*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard unit	0.001 lb a.i./tree, in water at 2 gal/tree 2 applications to 1,700 trees	Cumulative maximum = 1.6 lb a.i./acre per year 0.002 lb a.i./tree, in water at 4 gal/tree 2 applications to 500 trees	May - Jul	Every 2 to 3 years

Table 3 lists the proposed no-application buffers at Sprague.

Table 3. BLM Sprague Proposed Minimum No-Application Buffers

Pesticide	Application Method	Minimum Stream Buffer (ft)
B.t. Chlorothalonil Chlorpyrifos Diazinon Esfenvalerate Horticultural oil Permethrin Potassium salts of fatty acids Propargite	High-pressure hydraulic sprayer	90
Dicamba Glyphosate	Tractor-pulled spray rig with boom	40
acephate *B.t.* Chlorothalonil Chlorpyrifos Diazinon Dicamba Dimethoate Esfenvalerate Glyphosate Permethrin Picloram Potassium salts of fatty acids Propargite	Hydraulic sprayer with handheld wand	40

Pesticide	Application Method	Minimum Stream Buffer (ft)
Dicamba Dimethoate Esfenvalerate Glyphosate Permethrin Picloram Potassium salts of fatty acids Propargite	Backpack sprayer	40
Dicamba Glyphosate	Hand-held wick	20
Acephate Imidacloprid	Capsule implantation	60
Fertilizers	Broadcast spreader	40

Annual Monitoring and Reporting Requirements

The BLM has proposed a methodology for water quality monitoring whenever a pesticide or fertilizer covered under the BA is proposed for use. The plan covers four types of monitoring: (1) Implementation monitoring; (2) effectiveness monitoring; (3) validation monitoring, and (4) compliance monitoring.

The overall objective of the monitoring program at Sprague is to document the impacts of IPM actions on water quality, and to use this information to continue or modify the protection measures needed to meet the requirements for a healthy aquatic ecosystem. A full assessment of protection measures used in Sprague requires monitoring both groundwater and surface water.

Implementation Monitoring. All pesticide applications will be documented by Sprague's manager or designated representative. Items to be documented include: (1) Type of chemical applied; (2) the date of application; (3) the method of application; (4) the area treated; (4) the amount applied; (5) precipitation amounts for the three days preceding and following application; (6) the location used for mixing and loading; (7) wind direction and speed; (8) relative humidity and air temperature; and (9) notes regarding whether any leakage or spills occurred. A list of all protection measures and limitations for each orchard unit receiving pesticide or fertilizer application will all be provided in the Annual Sprague Monitoring Report.

Implementing protection measures and analyzing monitoring data of all types depends heavily on quality climate information. Maintenance of the existing seed orchard weather stations will continue providing real-time climate data including air temperature, precipitation, wind speed, wind direction, and relative humidity. These data will provide documentation of compliance and information to predict runoff patterns for effectiveness and validation monitoring.

Monitoring of Effectiveness of CPs.

Drift Card Monitoring. All orchard units planned for high-pressure hydraulic sprayer applications of chemicals and beside flowing streams will have spray cards placed so drift from the application can be captured and characterized. Orchard units or treatment areas directly beside open water (within 100 feet) will require drift cards be placed at a maximum of 100-foot intervals along the edge of the Sprague unit before the application. If open canopy occurs in the waterway buffer, drift cards will be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Immediately after the application, the cards will be collected and reviewed to determine if a drift signature is present, the extent of the drift, and the potential for aquatic contamination. A copy of all the cards will be kept on file at the seed orchard along with a record of their location and all compliance monitoring documentation.

Surface Water Monitoring. For high-pressure hydraulic sprayer applications of chemicals, water samples will be collected before and after spray application as per Oregon Department of Forestry (ODF) (1997) protocols and site-specific 'time of concentration' measurements. Selection of sampling stations for surface water sampling will be based on the proximity to application areas.

All data will be used in conjunction with the spray cards to determine the effectiveness of the full 'suite' of protective measures implemented to avoid drift. Samples will be analyzed at a state-certified laboratory that has detection limits of 0.02 parts per billion (ppb) for most of the potential pesticides. Samples will be collected in accordance with laboratory instructions. When sites are sampled, additional interpretive data will be collected for pH, specific conductance, turbidity, and temperature.

Surface Runoff. Pesticide and fertilizer fate modeling from the risk RA indicates that field runoff events within the first six months after spray application have the highest probability for carrying detectible concentrations of chemicals. One study (Rashin and Graber 1993) determined that runoff events within the first 72 hours of application, were the most important in terms of increases in detectible pesticide concentrations. Effectiveness monitoring of protective measures and limitations in the proposed action will target those periods of precipitation that could result in field surface runoff and increased streamflow. These periods are most likely to carry the greatest detectible concentrations of chemicals. If a surface water runoff event occurs after spring applications, these events will be sampled.

Continuous flow recording stations will be established to collect water and sediment samples on a flow-weighted basis with the intention of providing individual storm concentrations for multiple runoff events. The data from recording stations will represent water quality conditions resulting from the effectiveness of implemented protection measures and limitations in the higher-risk seed production orchard units.

All data will be used in conjunction with continuous recorded climate data to evaluate the effectiveness of protection measures and limitations in minimizing introduction of pesticides and

fertilizers to the aquatic system. Samples will be analyzed at a state-certified laboratory that has detection limits of 0.02 ppb for most of the potential pesticides. Samples will be collected in accordance with laboratory instructions.

Subsurface Runoff. Monitoring will provide an indication of the buffer area effectiveness, and over time will provide information for future pesticide applications with the use of buffer areas.

Cumulative Concentrations Runoff. Stormflow with the highest potential for chemical presence will be sampled, and during these flow events, samples will often be composited according to the rise and fall of the hydrograph, which in turn can inadvertently diminish concentrations.

In an effort to address these issues and answer the cumulative effects question, semi-permeable membrane devices (SPMDs) will be deployed, to monitor the accumulation of chemicals in waters containing aquatic species. The SPMD is an instream 'accumulator' which allows calculation of an average chemical concentration during the period of deployment. For this reason, the SPMDs will only be deployed during the initial winter storms and spring storm periods after pesticide application.

Stream flow gauges (United States Geological Survey [USGS] and BLM) will be maintained to provide flow data for deriving concentrations (chemical loading) over the period of time the SPMD is deployed. Data from the SPMD concentrations will be used to compare and validate the storm flow concentration monitored during the deployment period.

Monitoring Related to Modeled Concentrations. Validation monitoring is intended to verify the water quality modeling predictions presented in the EIS. Monitoring the stream systems will identify the effectiveness of protection measures, and to help to gauge the estimates in the RA.

Collection chambers will be installed in areas where there are concerns regarding overland flow. During the first overland flow event following select chemical applications, these sites will be visited, and a water sample taken from the collection chamber. Once the first surface runoff event is captured and results become available, the need to sample later runoff events will be determined based on concentrations detected. In the short term, these data will be used to assess the mobility of chemicals with high aquatic toxicity. Concentrations will be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.

Stream concentrations will also be compared to model results using actual application information, field-specific data, and continuous climate record. These data will provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period will be used to model a predicted concentration using the Groundwater Loading Effects of

Agricultural Management Systems (GLEAMS)[1] and Method of Characteristics (MOC)[2] models. These concentrations will be 'diluted' using the continuous flow data from the station. The resulting concentrations will be compared with the actual measured concentrations for each storm event sampled.

Compliance Monitoring.

Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, will be evaluated to determine if water sampling is desirable and necessary. If so, water samples will be collected in a sufficient number and at surface water and groundwater locations that will allow characterization of impacts and effective remediation methods. At a minimum, sampling will be conducted in the streams draining the spill area and the immediate groundwater table. The Sprague domestic well will be sampled if in proximity to spill.

A spill prevention plan will be developed before any pesticide applications, and be part of Sprague's Pesticide Safety Plan. The spill prevention plan will minimize or eliminate the risk of a pesticide spill for any pesticide operation. Sprague will develop a model or general pesticide spill plan which will address concerns and identify such factors as: (1) Critical sites where spills will likely occur, such as narrow road or stream/waterway crossings, soft soil or roadway areas, and rough roads; (2) mechanical or operational requirements, such as tire tread to reduce blowouts, speed limits at critical roadway curves or other areas, and quantity carrying capacity of tanks/vehicles at safe levels to prevent roll-overs and sloshing; (3) environmental restrictions, such as rainfall limits and standing water limits; and (4) approved mixing sites. At the operational level, the plan will include specific routes of the equipment, load limits for equipment, allowable speeds on the routes, mixing site limits in quantities, chemical types, or spill potential.

Groundwater Monitoring. Two irrigation/domestic wells and one proposed test well at Sprague are available for monitoring tests to be performed according to the parameters outlined by the Oregon Department of Health. A water sample could be taken from the wells on a yearly basis during maximum well usage for pesticide tests. The pesticide chosen will vary according to the rates, persistence, and mobility of the pesticides applied during the period since the last sampling. These samples will normally be collected in late summer and handled according to state-certified laboratory instructions.

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[1] The GLEAMS model, developed by the USDA Agricultural Research Service, is a computerized mathematical model developed for field-sized areas to evaluate the movement and degradation of chemicals within the plant root zone under various crop management systems. The model has been tested and validated using a variety of data on pesticide movement. A more detailed discussion of the GLEAMS model can be found in the Sprague RA Sec 3-13.

[2] MOC is a two-dimensional groundwater flow and chemical transport model, developed by the U.S. Geological Survey and is designed to account for the attenuating affect of buffer zones.

Annual Reporting. All water quality monitoring information associated with application of the Sprague Seed Orchards IPM program will be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' will include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, will be contained in an Annual Sprague Monitoring Report. This report will be available to the public and regulatory agencies on November 15 of each year and be on file at Sprague. BLM will request that NMFS' review of this Plan be completed by January 15 of the following year. This schedule will provide for timely inclusion of monitoring results in the Annual Operating Report and inclusion of the full period of runoff during the fall/winter period and planning for the upcoming budget year.

Framework for Multi-Year Consultation

In light of emerging new information (*i.e.* new scientific data, parallel section 7 consultation with EPA, and legal actions and decisions summarized above) the BLM has included within the proposed action a methodology to facilitate multi-year consultation. After the issuance of the Opinion, BLM will continue to obtain and provide information and NMFS will continue to monitor the status of the IPM program at the seed orchard, using the following process:

1. The seed orchard will implement the monitoring program as described above.

2. An Annual Operation Report will be prepared by Sprague and submitted to NMFS. This report will include:

   a. A description of pesticide applications conducted over the reporting period
   b. The results of the previous year monitoring program.
   c. A data review on the pesticides that are proposed for use, or may be used, at Sprague the following year. A single review will cover pesticides proposed at all four seed orchards. The review will include new scientific data regarding non-target fish species effects or environmental fate, changes to EPA-approved labels, and legal findings relevant to the use of the pesticides. Any new data will be considered in terms of effects on seed orchard use as proposed in the BA and on the conclusions of the EIS RA.
   d. A plan for proposed pesticide applications for the following year, including units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored. This plan will note that it may be possible for the seed orchard manager to schedule some applications, such as roadside vegetation management or insecticides for cone and seed insects in units that will be harvested to meet specific seed needs, in advance, and they will be fully described. However, the seed orchard manager will have the flexibility to use any of the applications as described in Table 3-1 of the BA, to respond to unforeseen pest management needs (for example, detection of disease or an insect infestation).

e. Any proposed changes to the selected alternative as described in the EIS and Record of Decision (ROD), including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those listed in Table 3-1; or other relevant information

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3. A new BA providing an updated effects analysis will be submitted to NMFS with the Annual Operation Report if the data review:

a. Identifies new scientific data or labeling details describing additional effects to listed species.
b. Identifies proposed changes to the selected alternative as described in the EIS and ROD.
c. Determines that monitoring data following pesticide applications indicate that effects are greater than anticipated.

Approach to Finding New Information on Chemicals Proposed for Use at Sprague. Before the analysis phase begins, the BLM would identify the relevant technical literature for the pesticide or pesticides in question. The ESA requires that Federal agencies use the best scientific and commercial data available [50 C.F.R. 402. 14(d)]. This section provides an overview of search and acquisition strategies that will be used to identify peer-reviewed data and other forms of scientific evidence that are relevant to Pacific salmon and steelhead.

Online Scientific Databases. The literature search for each active ingredient, as well as inert ingredients, adjuvants, surfactants and degradates will include keyword-based queries of several scientific databases. In addition to EPA's ECOTOX database, the targeted databases will include Aquatic Sciences and Fisheries Abstracts, Medline, Web of Science, AGRICOLA, Chem Abstracts, and BIOSIS. The searches will also be supplemented with literature abstracting databases including Toxline, Toxnet, and Current Contents: Agriculture, Biology, and Environmental Sciences.

Keywords. Scientific databases will be searched with keywords that are specific to fish or known invertebrate prey species for salmon or steelhead.[3]

Paper-Based Searches. Paper-based searches of bibliographies, guidance documents, modeling studies, and review articles will be conducted to identify primary sources of relevant

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[3] For fish, all keywords, or an appropriate subset, will include *salmonid, Chinook salmon, coho salmon, steelhead salmon, chum salmon, sockeye salmon, pink salmon, Atlantic salmon, cutthroat trout, bull trout, rainbow trout, char, Oncorhynchus mykiss, O. tshawytcha, O. kisutch, O. nerka, O. gorbuscha, O. clarkii, Salmo, Salvelinus, alevin, fry, parr, smolt, and fish.* For potential impacts to invertebrate prey species, all keywords, or an appropriate subset, will include *chironomid, mayfly, stonefly, copepod, amphipod, mysid, cladoceran, Chironimidae, Simuliidae, Ephemeroptera, Plecoptera, Neoptera, Trichoptera, Copepoda, Diptera, Gammaridae, Daphnia.* For potential impacts on primary production in aquatic systems, all keywords, or an appropriate subset, will include *algae, diatom, periphyton, Chlorella, and Selenastrum.* Additional keywords may be used as appropriate. For each pesticide, the active ingredient, inert ingredient(s), adjuvant, surfactant, degradate(s), product name(s), and Chemical Abstract Registry Number (CAS RN) will be used in the database search.

scientific information. In addition, data provided in support of pesticide registrations will be considered.

Other Actions Not Covered Under The BA. Herbicides use for competing vegetation (non-noxious applications) are not covered within this Opinion.

Action Area

'Action area' means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 C.F.R. 402.02). For purposes of this consultation, the action area for this consultation includes the areas of Jump-off Joe Creek below Sprague, and the Rogue River for several miles after it's confluence with Jump-off Joe Creek.

The action area is used by SONC coho salmon for all life history stages, and is designated as critical habitat. The project area is also designated as EFH for Pacific Coast salmon (PFMC 1999), or is in an area where environmental effects of the proposed project may adversely affect designated EFH for those species.

ENDANGERED SPECIES ACT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with USFWS and NMFS, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats.

Section 9(a)(1) and protective regulations adopted pursuant to section 4(d) of the ESA prohibit the 'taking' of listed species without a specific permit or exemption. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). 'Incidental take' refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

Biological Opinion

This Opinion presents NMFS' review of the status of each evolutionarily significant unit (ESU)[4] considered in this consultation and critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects. An analysis of those combined factors is used to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESUs, or is likely to destroy or adversely modify designated critical habitat (50 C.F.R. 402.14(g)). If the action under consultation is likely to jeopardize an ESU, or destroy or adversely modify designated critical habitat, NMFS must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 C.F.R. 402.02).

Status of the ESU

This section defines range-wide biological requirements of each ESU, and reviews the status of the ESUs relative to those requirements. The present risk faced by each ESU informs NMFS' determination as to whether additional risk would 'appreciably reduce' the likelihood of both survival and recovery in the wild. The greater the present risk, the more likely any additional risk resulting from the proposed action's effects on the population size, trend (growth rate), distribution, and genetic diversity of the listed species would be an appreciable reduction (McElhaney *et al.* 2000).

Coho salmon. Coho salmon is a widespread species of Pacific salmon, occurring in most major river basins around the Pacific Rim from Monterey Bay in California, north to Point Hope, Alaska, through the Aleutians, and from the Anadyr River south to Korea and northern Hokkaido, Japan (Laufle *et al.* 1986). From central British Columbia south, the vast majority of coho salmon adults are 3-year-olds, having spent approximately 18 months in freshwater and 18 months in saltwater (Gilbert 1912; Pritchard 1940; Sandercock 1991). The primary exceptions to this pattern are 'jacks,' sexually mature males that return to freshwater to spawn after only 5 to 7 months in the ocean. However, in southeast and central Alaska, the majority of coho salmon adults are 4-year-olds, having spent an additional year in freshwater before going to sea (Godfrey *et al.* 1975; Crone and Bond 1976). The transition zone between predominantly 3-year-old and 4-year-old adults occurs somewhere between central British Columbia and southeast Alaska.

With the exception of spawning habitat, which consists of small streams with stable gravels, summer and winter freshwater habitats most preferred by coho salmon consist of quiet areas with low flow, such as backwater pools, beaver ponds, dam pools, and side channels (Reeves *et al.*

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[4] 'ESU' means an anadromous salmon or steelhead population that is either listed or being considered for listing under the ESA, is substantially isolated reproductively from conspecific populations, and represents an important component of the evolutionary legacy of the species (Waples 1991). An ESU may include portions or combinations of populations more commonly defined as stocks within or across regions.

1989). Habitats used during winter generally have greater water depth than those used in summer, and also have greater amounts of large woody debris. West Coast coho smolts typically leave freshwater in the spring (April to June) and re-enter freshwater when sexually mature from September to November and spawn from November to December and occasionally into January (Sandercock 1991). Stocks from British Columbia, Washington, and the Columbia River often have very early (entering rivers in July or August) or late (spawning into March) runs in addition to 'normally' timed runs.

The status of coho salmon for purposes of ESA listings has been reviewed many times, beginning in 1990. The first two reviews occurred in response to petitions to list coho salmon in the Lower Columbia River and Scott and Waddell Creeks (Central California) under the ESA. The conclusions of these reviews were that NMFS could not identify any populations that warranted protection under the ESA in the Lower Columbia River (Johnson *et al.* 1991), and that the Scott and Waddell Creeks' populations were part of a larger, undescribed ESU (Bryant 1994).

A review of West Coast (Washington, Oregon, and California) coho salmon populations began in 1993 in response to several petitions to list numerous coho salmon populations and NMFS' own initiative to conduct a coastwide status review of the species. This coastwide review identified six coho salmon ESUs, of which the three southern-most were proposed for listing, two were candidates for listing, and one was deemed 'not warranted' for listing (Weitkamp *et al.* 1995). In October 1996, the Biological Review Team (BRT) updated the status review for the Central California (CC) ESU, and concluded that it was at risk of extinction (NMFS 1996a). In October 1996, NMFS listed this ESU as threatened on May 6, 1997 (62 FR 24588), protective regulations were applied on July 18, 1997 (62 FR 68479), and critical habitat was designated on May 5, 1999 (64 FR 24049).

In December 1996, the BRT updated the status review update for both proposed and candidate coho salmon ESUs (NMFS 1996b). However, because of the scale of the review, comanagers' requests for additional time to comment on the preliminary conclusions, and NMFS' legal obligations, the status review was finalized for proposed coho salmon ESUs in 1997 (NMFS 1997), but not for the candidate ESUs. In May 1997, NMFS listed the SONC ESU as threatened, while it announced that listing of the Oregon Coast (OC) ESU was not warranted due to measures in the Oregon Coho Salmon Restoration Initiative (OCSRI) plan. This finding for SONC coho salmon was overturned in August 1998, and the ESU listed as threatened.

The process of updating the coho salmon status review was begun again in October 1998 for coho salmon in Washington and the Lower Columbia River. However, this effort was terminated before the BRT could meet, due to competing activities with higher priorities.

In response to a petition by Oregon Trout *et al.* (2000), the status of Lower Columbia River (LCR) coho salmon was revisited in 2000, with BRT meetings held in March and May 2001 (NMFS 2001a). The BRT concluded that splitting the LCR/Southwest Washington coast ESU to form separate LCR and Southwest Washington coast coho salmon ESUs was most consistent

with available information and the LCR ESU was at risk of extinction. Like the 1996 status review update, these results were never finalized.

The coho salmon BRT met in January, March and April 2003 to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRTs.

Southern Oregon/Northern California Coasts (SONC) Coho Salmon. The SONC coho salmon ESU extends from Cape Blanco in southern Oregon, to Punta Gorda in northern California (Weitkamp *et al.* 1995). The status of coho salmon coastwide, including the SONC coho ESU, was formally assessed in 1995 (Weitkamp *et al.* 1995). Two subsequent status review updates have been published by NMFS, one addressing all West Coast coho salmon ESUs (NMFS 1996b) and a second specifically addressing the OC and SONC ESUs (NMFS 1997).

In the 1995 status review, the BRT was unanimous in concluding that coho salmon in the SONC coho ESU were not in danger of extinction but were likely to become so in the foreseeable future if present trends continued (Weitkamp *et al.* 1995). In the 1997 status update, estimates of natural population abundance in this ESU were based on very limited information. Favorable indicators included recent increases in abundance in the Rogue River and the presence of natural populations in both large and small basins, factors that may provide some buffer against extinction of the ESU. However, large hatchery programs in the two major basins (Rogue and Klamath/Trinity) raised serious concerns about effects on, and sustainability of, natural populations.

New data on presence/absence in northern California streams that historically supported coho salmon were even more disturbing than earlier results, indicating that a smaller percentage of streams in this ESU contained coho salmon compared to the percentage presence in an earlier study. However, it was unclear whether these new data represented actual trends in local extinctions, or were biased by sampling effort. This new information did not change the BRT's conclusion regarding the status of the SONC coho ESU. Although the OCSRI proposals were directed specifically at the Oregon portion of this ESU, the harvest proposal would affect ocean harvest of fish in the California portion as well. The proposed hatchery reforms can be expected to have a positive effect on the status of populations in the Rogue River Basin. However, the BRT concluded that these measures would not be sufficient to alter the previous conclusion that the ESU is likely to become endangered in the foreseeable future.

One effect of the OCSRI has been increased monitoring of salmon and habitats throughout the Oregon coastal region. Besides continuation of the abundance data series analyzed in the 1997 status update, Oregon has expanded its random survey monitoring to include areas south of Cape Blanco, including monitoring of spawner abundance, juvenile densities, and habitat condition.

New data for the SONC coho salmon ESU includes expansion of presence-absence analyses, a limited analysis of juvenile abundance in the Eel River Basin, a few indices of spawner

abundance in the Smith, Mad, and Eel River Basins, and substantially expanded monitoring of adults, juveniles, and habitat in southern Oregon. None of these data contradict conclusions reached previously by the BRT. Nor do any of recent data (1995 to present) suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONC coho ESU. Coho salmon populations continued to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Although the 2001 broodyear appears to be the one of the strongest perhaps of the last decade, it follows a number of relatively weak years. The Rogue River stock is an exception; there has been an average increase in spawners over the last several years, despite two low years (1998, 1999).

Risk factors identified in previous status reviews, including severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that are clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continue to be of concern to the BRT. Termination of hatchery production of coho salmon at the Mad River and Rowdy Creek facilities has eliminated potential adverse risk associated with hatchery releases from these facilities. Likewise, restrictions on recreational and commercial harvest of coho salmon since 1994 have undoubtedly had a substantial positive impact on coho salmon adult returns to SONC streams. An additional risk factor that has been identified within the SONC coho ESU is predation resulting from the illegal introduction of non-native Sacramento pikeminnow (*Ptychocheilus grandis*) to the Eel River Basin (NMFS 1998). Sacramento pikeminnow were introduced to the Eel River via Pillsbury Lake in the early 1980s, and have subsequently spread to most areas within the basin. The rapid expansion of pikeminnow populations is believed to have been facilitated by alterations in habitat conditions, particularly increased water temperatures, that favor pikeminnow (Brown *et al.* 1994; NMFS 1998).

A majority (67%) of BRT votes fell into the 'likely to become endangered' category, while votes in the 'endangered' category outnumbered those in the 'not warranted' categories by 2-to-1. The BRT found moderately high risks for abundance and growth rate/production, with mean matrix scores of 3.5 to 3.8, respectively, for these two categories. Risks to spatial structure and diversity were judged by the BRT to be moderate.

The BRT remained concerned about low population abundance throughout the ESU relative to historical numbers and long-term downward trends in abundance; however, the paucity of data on escapement of naturally-produced spawners in most basins continued to hinder assessment of risk. A reliable time series of adult abundance is available only for the Rogue River. These data indicate that long-term (22-year) and short-term (10-year) trends in mean spawner abundance are upward in the Rogue; however, the positive trends reflect effects of reduced harvest (rather than improved freshwater conditions) since trends in pre-harvest recruits are flat. Less-reliable indices of spawner abundance in several California populations reveal no apparent trends in some populations and suggest possible continued declines in others.

Additionally, the BRT considered the relatively low occupancy rates of historical coho salmon streams (between 37% and 61% from broodyear 1986 to 2000) as an indication of continued low

abundance in the California portion of this ESU. The relatively strong 2001 broodyear, likely the result of favorable conditions in both freshwater and marine environments, was viewed as a positive sign, but was a single strong year following more than a decade of generally poor years.

The moderate risk matrix scores for spatial structure reflected a balancing of several factors. On the negative side was the modest percentage of historical streams still occupied by coho salmon (suggestive of local extirpations or depressed populations). The BRT also remains concerned about the possibility that losses of local populations have been masked in basins with high hatchery output, including the Trinity, Klamath, and Rogue systems. The extent to which strays from hatcheries in these systems are contributing to natural production remains uncertain; however, it is generally believed that hatchery fish and progeny of hatchery fish constitute the majority of production in the Trinity River, and may be a significant concern in parts of the Klamath and Rogue systems a well. On the positive side, extant populations can still be found in all major river basins within the ESU. Additionally, the relatively high occupancy rate of historical streams observed in broodyear 2001 suggests that much habitat remains accessible to coho salmon. The BRT's concern for the large number of hatchery fish in the Rogue, Klamath, and Trinity systems was also evident in the moderate risk rating for diversity.

Coho Salmon Habitat Use in the Action Area. Various life-stages of coho salmon are likely to be in Jump-Off Joe Creek and the Rogue River throughout the year. The nearest coho salmon habitat is one mile downstream from Sprague. Coho salmon use the lower 12 miles of Jump-off Joe Creek for spawning and rearing. Coho salmon eggs incubate in gravel redds in rivers, then hatch as the larval stage called alevins, which depend on food stored in a yolk sac. After the yolk sac is absorbed, juvenile coho salmon emerge from the gravel nest as fry during late winter/early spring. Juvenile coho rear in slow fresh water habitats for one year, after which they migrate to the ocean as smolts. Coho smolts typically migrate to sea in the spring, spend 16 to 20 months rearing in the ocean, then return to freshwater as adults in the fall and spawn from October to January. Adult coho salmon will migrate above stream segments with cascades or rapids if an unconstrained or low-gradient stream segment with suitable spawning habitat is present upstream.

As displayed in Table 4, coho salmon in the action area likely spend one year in freshwater and eighteen months in saltwater. Variation from this pattern does occur, with some juvenile coho salmon spending a second summer in freshwater areas.

Table 4. Coho Salmon Use in Jump-off Joe Creek and Rogue River

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Adult Immigration /Holding												
Adult Spawning												
Incubation/ Emergence												
Juvenile Rearing												
Juvenile emigration												

Shaded months indicate particular lifestage use.

Environmental Baseline

The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. 402.02). For projects that are ongoing actions, the effects of all past actions are part of the environmental baseline and the effects of future actions over which the Federal agency has discretionary involvement or control will be analyzed as 'effects of the action.'

Analysis of the environmental baseline is guided by the specific habitat components necessary to support SONC coho within the action area. When the environmental baseline departs from conditions that support those biological requirements, it becomes more likely that additional risk to the ESU resulting from the effects of the proposed action on the ESU or its habitat will result in jeopardy (NMFS 1999). The biological requirements of SONC coho in the action area vary depending on the life history stage present and the natural range of variation present within that system (Groot and Margolis 1991; NRC 1996; Spence *et al.* 1996).

Generally, during spawning migrations, adult salmon require clean water with cool temperatures or thermal refugia, dissolved oxygen near 100%, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Spawning areas are selected based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*i.e.*, gravel size, porosity, permeability, and oxygen levels), substrate

stability during high flows, and, for most species, water temperatures of 13°C or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether they are ocean, lakes, or other stream reaches, requires unobstructed access to these habitats. Physical, chemical, and thermal conditions may all impede migrations of adult or juvenile fish.

The SONC coho ESU considered in this Opinion resides in or migrates through the action area. Thus, for this action area, the biological requirements for SONC coho are the habitat characteristics that would support successful migration, spawning, incubation, rearing and emigration.

The Sprague Seed Orchard is in the Rogue River Basin at the headwaters of Jump-off Joe Creek, which drains into the Rogue River. The BLM summarizes the drainages within the Sprague as follows:

> The Sprague Seed Orchard totals 200 acres. It is divided into a northwestern and southeastern portion. The northwestern area occupies 160 acres, and all of the surface waterways are there. These are all intermittent streams, which means they typically flow during the late fall, winter, and spring period of higher precipitation. The largest intermittent stream is on the western side of the property. It usually flows through early summer. The stream enters the property about 500 feet south of the northwest corner, and flows southeast down the western side of the property. This intermittent stream has a buffer of riparian vegetation approximately 40 to 60 feet on each side of the stream. There are several small natural drainages flowing into it. To the east, there are several other intermittent streams that flow only during storm events. These intermittent streams have a buffer of approximately 25 to 50 feet on each side of the stream portions. They flow south and join the larger stream just south of the property boundary.
>
> On the eastern side, there are several more intermittent streams that flow seasonally. One of these flows south along the west side of the reservoir. The one in the easternmost corner is a wet area when it first enters the property. The water then flows into the stream and joins another stream to the south, where they cross the railroad tracks and flow into the reservoir from the northwest. These all have approximately 20- to 30-foot buffers on both sides. There is one other small intermittent stream that flows into the reservoir from the northeast, at the property boundary.
>
> The orchard's reservoir, created in 1968 and called "Lake Casso," is in the southeast corner of the northern 160 acres. There are two inlets and one outlet. The outlet is a spillway that flows south, joining one of the intermittent streams and then flowing off the property. The reservoir has a surface area of 2.9 acres and a storage capacity of 16 acre-feet, with an average depth of six feet. The drainage area above the reservoir is 0.86 square mile (550 acres), and the water source is from two intermittent creeks and an orchard well ("Well 1"). An average of 0.15 acre-feet is lost per day by seepage. The reservoir has a sandy loam bottom and trees around its perimeter. It is used as a pump

> chance (wildfire water source) and for wildlife habitat....Neighboring land uses in the surrounding area include rural residential, homes with small acreages, forest land of mixed conifer and hardwoods (both privately owned and other BLM property) and small towns and communities. The Central Oregon and Pacific Railroad line runs through the seed orchard. Other agencies or private individuals in the vicinity of the orchard may be using other (pesticide) treatments with many of the same chemicals as BLM proposes to use; however, it is unknown which chemicals may be used or the extent to which chemicals may be used in Jump-off Joe Creek. Applications of pesticides and fertilizers may be used in agriculture, forestry, or industrial applications by the surrounding landowners and create an overall chemical burden in the orchard area. Informal conversations and observation by seed orchard personnel indicate that local pesticide use may include heavy herbicide application along the railroad right-of-way, and rural residential home and garden use of pesticides and fertilizers (BLM 2004).

All of the Sprague drainages eventually drain into Jump-off Joe Creek, which is on the Oregon Department of Environmental Quality (ODEQ) list of water quality-limited streams under Section 303(d) of the Clean Water Act. It was listed for temperature both in 1998 and 2002, temperatures have been documented as high as 77.9°C.

A NMFS matrix of pathways and indicators (MPI) was prepared by the BLM for several baseline conditions in Jump-off Joe Creek. The MPI method assesses the current condition of instream, riparian, and watershed factors that collectively provide for a properly functioning aquatic habitat, essential for maintaining salmonid populations. Environmental baselines are categorized as either "properly functioning," "at risk," or "not properly functioning." The only factors that were determined to be functioning properly in Jump-off Joe Creek were streambanks and landslide rates. Water quality and habitat access were determined to be at risk due to chemical contamination/nutrients and human-caused physical barriers, respectively. All other factors were determined to be not properly functioning.

More specifically, the BLM has completed a comprehensive Jump-off Joe Creek Watershed analysis (BLM 1998). This watershed analysis provides a status of the current condition of the watershed, including mechanisms which limit aquatic habitat productivity:

> Historically, Jumpoff Joe Creek provided some of the best habitat for anadromous fish in the Rogue River Basin. Habitat includes streambed substrate quality and quantity available for spawning, pools, large woody debris and log jams and good quality and quantity of water for fish rearing. The mainstem is dewatered at the mouth annually from irrigation and is considered having "areas of lost fish production." Fish production will never reach an optimum level while water quantity is limited. All streams in the Jumpoff Joe Watershed characteristically have the same primary factors limiting salmonid production: (1) Instream habitat complexity is lacking in large woody debris, greater than or equal to 24 inches in diameter and the length should be equal to or greater than the bankfull width; (2) stream shade less than 60%; (3) lack of mature trees, especially

conifers, >32-inches in diameter within 100 feet from the stream; (4) better flows in the lowlands, and (5) the amounts of coarse wood will vary depending on the plant series.

The streams in Jumpoff Joe Watershed have been channelized from agricultural and mining practices and road construction. Channelizing has prevented the streams from meandering and forming side channels. Meandering side channels provide more fish habitat or refugia than a single channel. Channelizing streams has disconnected the floodplain with the channel and has probably decreased fish rearing capability over the past century. Presently there is no connectivity between the stream and the floodplain where streams are channelized. Few if no side channels exist for rearing. Channelization causes water flows to accelerate which can decrease fish and insect production.

The lower reach of Jumpoff Joe Creek consists of good salmonid habitat except during intermittent flow periods. A waterfall is impassable to coho under low-flow periods. There is a lack of large wood in the stream and riparian areas. The riparian consists of 30% shade and the wide stream is exposed largely to the sunlight. Stream temperatures are in the 70's F. Redside shiners, suckers and dace exist in this reach and are competitors with salmonids for space and food. Numerous juvenile cutthroat trout can be found in isolated pools during the low flow period. Mature alder are dominant in the riparian landscape. Mature pine were harvested and young conifers are succeeding. Spawning substrate is limited, yet production of salmonids is low to moderate, with a large amount of cobble and bedrock....Low flows and lethal temperatures limit rearing potential up to mile 14.5. Extensive gravel removal operations have removed salmonid spawning habitat (BLM 2004).

The BLM analysis point to a number of factors which effect water quality in the basin. Water temperatures are elevated because of a combination of riparian tree loss from road building, logging residential development, and grazing, high channel width to depth ratios, and water withdrawals. The BLM also identified extensive mining, roads, and past tree harvest to increased turbidity/sediment levels. In addition to being a sediment source, roads confine the stream channel and restrict the natural tendency of streams to move laterally. This can lead to down cutting of the streambed or erosion of the streambank opposite the road. Habitat has been simplified through large woody debris loss, which can lead to channel instability, and reduce reduced velocity holding and rearing pools that are preferred by coho salmon.

The Rogue Basin drains 5,058 square miles in Southwestern Oregon and Northern California. The Rogue River flows west from the headwaters in the Cascades near Crater Lake through interior valleys and coast range mountains of Southwest Oregon to the Pacific Ocean. The Rogue system has two main dams managed by the U.S. Army Corps of Engineers, several large diversion impoundments, and hundreds of smaller water diversions affecting fish distribution. The dams have significantly altered the natural flow and temperature regime, and impaired fish passage and distribution in the Rogue River Basin.

Soils. Two types of soil are present at Sprague: Holland sandy loam and Manita loam (SCS 1983). The cation exchange capacity of each of these soils is in the range of 5 to 25 meq/100 g, indicating that they contain smectite clay and low to moderate amounts of organic matter, which adsorbs pesticides and fertilizers and retards their movement through the soil. Table 5 presents soil characteristics relevant to the environmental mobility of fertilizers and pesticides.

Table 5. Soil Characteristics at Sprague

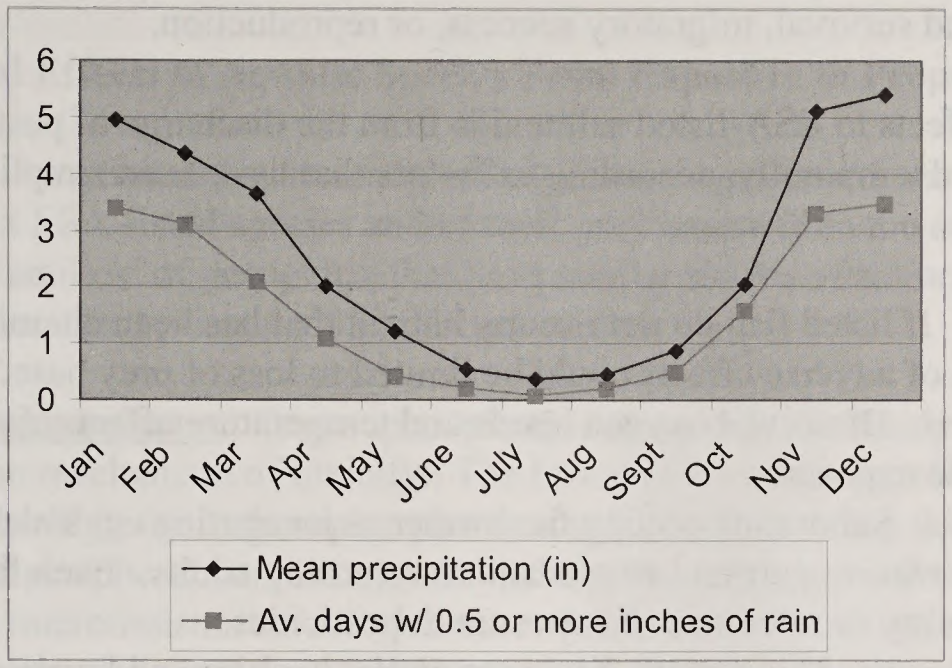
Soil Series	Depth (in)	Permeability (in/hr)	Depth to Water Table (ft)	Runoff	Slope (%)	Organic Matter (%)	Clay (%)	Soil Sensitivity
Holland C	0 – 14	2.0 – 6.0	> 6	medium	7 – 12	2 - 6	10 - 18	moderate
	14 – 28	0.2 – 0.6				1.0 - 2.0	22 - 30	
	28 - 49	0.6 – 2.0				0.5 - 1.0	15 - 35	
Holland E	0 -14	2.0 - 6.0	> 6	medium	20 – 35	2 - 6	10 - 18	low
	14 - 28	0.2 - 0.6				1.0 - 2.0	22 - 30	
	28 -49	0.6 - 2.0				0.5 - 1.0	15 - 35	
Manita	0 -11	0.6 - 2.0	> 6	slow	2 – 7	2 - 4	18 - 27	very low
	15 - 35	0.6 - 2.0				0.5 - 3	27 - 33	
	11 - 50	0.2 - 0.6				0.5 - 2	35 - 45	

Sources: SCS 1983, SCS 1993, OSUES 1998.

Weather. The average July temperature at Grants Pass is 69˚F, the average January temperature is 39˚ F, and average annual precipitation is 31 inches. As illustrated in Figure 1, below, most of the precipitation occurs between the months of November and March; consistent with the frequent Pacific storm patterns.

Precipitation during the spring and summer months is typically very light. Annual average relative humidity ranges from a high of about 92%, typically in early morning, to a low of 26%, typically in the early afternoon. Winds are predominantly from the north to northwest throughout the months of December through August and from the south from September through November.

Figure 1. Sprague Orchard Precipitation



Effects of the Proposed Action

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 C.F.R. 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, NMFS will evaluate the net combined effects of the proposed action and the offsite measures.

'Indirect effects' are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside the area directly affected by the action, and may include other Federal actions that have not undergone section 7 consultation but will result from the action under consideration. To be considered indirect effects, such actions must be reasonably certain to occur, as evidenced by appropriations, work plans, permits issued, or budgeting; follow a pattern of activity undertaken by the agency in the action area; or be a logical extension of the proposed action.

'Interrelated actions' are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 C.F.R. 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this Opinion.

The application of pesticides, herbicides and fertilizers in proximity to lakes and river systems can result in the transport of potentially toxic chemicals (active ingredients and/or adjuvants) to surface waters (USGS 1999) that may harm ESA-listed species. Pesticides, herbicides and fertilizers can impair the essential biological requirements of salmon if they undermine the

physical, chemical, or biological processes that collectively support a productive aquatic ecosystem (Preston 2002) or affect the physiological or behavioral performance of salmonids in ways that will reduce growth and survival, migratory success, or reproduction.

The degree, or likelihood, of effects to ESA-listed salmonids from the discharge of pesticides to surface waters vary spatially and temporally, according to factors that have been simplified into the following categories:

1. *Likelihood of Exposure.* If listed fish do not occupy habitat that has been chemically modified, the likelihood of adverse effects could be limited to loss of prey base.[5]
2. *Water Quality Conditions.* Dissolved oxygen levels and temperature affect salmonids susceptibility to pesticide exposure.
3. *Lifestage of the Salmonid.* Salmonids occupy freshwater as incubating eggs/alevins, newly-emerged fry, and rearing parr and smolts and as returning adults. Each lifestage has a different susceptibility or tolerance of exposure to pesticides.
4. *Levels of other Contaminants.* Concurrent discharge and/or background levels of other contaminants[6] can magnify adverse effects through mixture toxicity resulting from discharges associated with the IPM program.
5. *Concentration and relative toxicity of the chemical.*

Within the BA, the BLM evaluated expected effects from the pesticide portion of their IPM using models that assess potential delivery to aquatic systems from drift, surface runoff, and groundwater runoff. While these models are a viable analysis method to evaluate potential water concentrations, they generally do not account for many of environmental variables that can change the effects of pesticide applications. As applied, the models also did not account for the multitude of possible exposures that are proposed over the five-year implementation period. Background or concurrent delivery of pollutants from other sources, and degraded water quality within receiving waterways will add to the risk caused by pesticide delivery from BLM applications.

Most adverse effects to ESA-listed salmonids in the action area from the proposed IPM are likely to be sublethal. As stated in Rand (1995), sublethal effects to ESA-listed salmonids take the form of behavioral, physiological, biochemical, or histological changes in the exposed fish. These changes may not be immediately lethal, but can cause fish to exhibit impaired behaviors (*i.e.*, narcosis) or eventually develop a lower level of physical health, thus reducing their chances of survival as compared to unexposed fish. Possible consequences include loss of equilibrium, reduced swimming ability, and impaired predator avoidance behavior, which lead to increased

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[5] 'Prey base' refers to macroinvertebrates and aquatic plants that serve a food sources for juvenile salmonids. A loss of prey base upstream from areas occupied by ESA-listed salmon could result in decreased feeding opportunities downstream.

[6] Contaminants range from pesticides, herbicides and nutrients (phosphates and nitrates), to those associated primarily with road and urban runoff including heavy metals, and organics (*i.e.* oil and grease).

predation risk and reduced foraging ability. Increased mixture toxicity between the pesticides and other contaminants in receiving waterways is likely to occur and exacerbate these effects.

General Effects to Aquatic Species From Exposure to Proposed Compounds

The following is a general discussion of effects from the proposed pesticides that are likely to adversely effect ESA-listed species and/or their prey base within the action area. Effects are presented by 'families' of pesticides, that have similar modes of action to aquatic species, and are based on literature reviews and published studies.

Organophosphates. Organophosphates are a group of closely-related pesticides that share a common mechanism of toxicity. The insecticides acephate, chlorpyrifos, diazinon, and dimethoate fall within this organophosphate category and are being proposed for use at Sprague. The central and peripheral nervous system is the primary target by disrupting the enzyme that hydrolyzes the nuerotransmitter acetylcholine. Inhibition of this enzyme, acetylcholinesterase, results in an accumulation of acetylcholine which has the effect of continuous stimulation of cholinergic and muscarinic receptors. Organophosphates are highly toxic to fish. Acetylcholinesterase inhibition can result in impairment of biological functioning such as growth, maturation, sensory systems and reproduction. Sublethal behavioral effects can include swimming, foraging, predator avoidance, and disruption of migratory behavior.

Acephate. Acephate is a contact insecticide that is applied to leaf surfaces of plants where it is eaten or comes in contact with pests. Acephate acts by inhibiting the enzyme acetylcholinesterase which is necessary for control of nerve transmission (USDA 1995). Acephate is very water soluble, very mobile in soils, and degrades rapidly in soils under aerobic conditions (EPA 2001). Acephate is considered slightly toxic to aquatic invertebrates and freshwater fish. A summary of toxicity values for aquatic life published in the literature for acephate is found in section 8.3.1 in the Sprague RA. Sprague proposes to use Acecap® 97, which is 97% acephate in an implant capsule in Sprague units, there is no expected risk from capsule implantation to SONC coho salmon.

Methamidophos. Methamidophos, a degradate of acephate, is considered very highly toxic to aquatic invertebrates and slightly toxic to fish on an acute basis (EPA 2001). Acephate degrades to methamidophos in less than two days. This degradate has a slightly longer half-life (<10 days) (EPA 2001) and shares the high mobility of its parent pesticide. The BA predicted that acephate will reach water surface waters in negligible concentrations. This is probably due to its short anaerobic half-life, however, nothing is mentioned of its degradate. Methamidphos is significantly more toxic to the prey base of salmonids, more persistent, highly mobile, and carries with it a greater potential for adversely affecting salmonid habitat.

Chlorpyrifos. Chlorpyrifos is very highly toxic to fish and aquatic invertebrates (USDA 1995b). A summary of toxicity values for aquatic life published in the literature for chlorpyrifos is found in the Sprague RA. When released into the environment, the half-life of chlorpyrifos ranged from 11 to 141 days in a variety of different soil types; it is thus considered to be

moderately persistent (USDA 1995b). The potential for runoff into surface water could occur via erosion up to several months after application. Its degradate, TCP (3,5,6-trichloro-2-pyridinol), is a much more persistent chemical (>365 days) that exhibits much lower soil/water partitioning than chlorpyrifos and is highly water soluble. Within an area of continuous application, accumulated amounts of chlorypyrifos in the soil to will eventually degrade into TCP. A storm event could mobilize TCP through dissolution in runoff water and be transported to surface water in a persistent amount. However, TCP was found to be much less toxic than chlorpyrifos to aquatic organisms (EPA 2000a).

Diazinon. Diazinon is very toxic to freshwater aquatic organisms and very highly toxic to aquatic invertebrates on an acute basis. A summary of toxicity values for aquatic life published in the literature for diazinon is found in the Sprague RA. Exposure to low concentrations (1 ppm or less) has been determined to cause genetic damage and disrupts behaviors that are crucial for reproduction and protection from predators (Cox 2000). Diazinon is moderately mobile in soils and persistent in the environment (37 to 39 days) (EPA 2001b) Diazinon is potentially of the most concern of the organophosphate group. There is a higher exposure probability and risk with more soluble pesticides with longer half-lives than less soluble pesticides with a shorter half-lives. Reduced populations of macro-invertebrates that may result from acute concentrations of diazinon, although temporary, may indirectly effect the health of juvenile salmonids that prey on them.

Dimethoate. Dimethoate is highly toxic to fish and to aquatic invertebrates. A summary of toxicity values for aquatic life published in the literature for dimethoate is found in the Sprague RA. Dimethoate is highly soluble and highly mobile in soil, the potential of leaching and runoff to water is high. Dimethoate can be rapidly broken down by most soil microorganisms with soil half-lives ranging generally from 4 to 16 days, but as high as 122 days, have been reported; a representative value would be 20 days (Extoxnet 2000).

Environmental factors may also influence organophosphate toxicity to aquatic species, altering effect estimates to fish. In general, acute toxicity of chlorpyrifos and azinphos-methyl were found to increase with temperature, pH, and body size of the fish. Within the Jump-off Joe Creek Watershed, an number of anthropogenic disturbances result in stream temperatures that can stress aquatic life and can exacerbate organophosphate toxicity.

The Sprague BA lists relevant assessment endpoints and effect concentrations of acephate, chlorpyrifos, diazinon, and dimethoate and other relevant organophosphates to salmonid species.

Organosulfites. Propargite is an organosulfur miticide/acaricide that is highly toxic to fish, is moderately persistent (38-168 days), but is immobile in soils, and not very soluble in water. A summary of toxicity values for aquatic life published in the literature for propargite is found in the Sprague RA. Having a high affinity for soil and sediment, propargite has the potential to move off the site of application during rainfall/irrigation by erosion/runoff on soil particles and by drift. Given the moderate to slow degradation rates for metabolism and

photolysis, and the high Koc[7] values, propargite will probably partition to sediments and organic material if transported to surface waters (EPA 2000b). No data is available on environmental influences to toxicity.

Propargite. Propargite does not share a common mechanism of toxicity with other pesticides (EPA 2000b), and may not elicit a cumulative risk with other pesticides from a purely mechanistic perspective. However, it is a contributor to the overall pesticide burden that an aquatic organism may experience and could, in combination with other stressors, pose a significant risk in small amounts.

Pyrethroids. Pyrethroids, including esfenvalerate and permethrin, are highly toxic to aquatic invertebrates and fish. The pyrethroid group share similar mechanisms of toxicity, resembling that of Dichlorodiphenyltrichloroethane (known more commonly as 'DDT'), targeting the central and peripheral nervous system, resulting in greatly altered ionic currents and disrupted nerve function through membrane depolarization (Eisler 1992). Disruption to the neuromuscular system, through neurotoxic modes of action, can affect foraging behavior, predator avoidance, swimming performance and other coordinated muscular movement. Environmental factors may also influence pyrethroid toxicity to aquatic species. Toxicity has been known to increase with higher water temperatures, suspended sediments, and acidity.

Esfenvalerate. Esfenvalerate is very highly toxic to aquatic species. A summary of toxicity values for aquatic life published in the literature for esfenvalerate is found in the Sprague RA. The persistence of esfenvalerate varies on environmental conditions with half-lives in direct sunlight, soil, and water being 7.5 days, up to 90 days, and 10 to 220 days, respectively. Sublethal effects of inhibited olfactory response to a female reproductive pheromone were found at concentrations of less than 0.004 mu g/L or 4 parts per trillion in Atlantic Salmon (Moore and Waring 2001). The same study found exposure of milt and eggs to a concentration of 0.1 mu g/L reduced egg fertilization. These sublethal effects occur at low concentrations that would precede any effects realized at the individual level but could potentially have consequences at the population level.

Permethrin. Permethrin is highly toxic to fish and especially aquatic macroinvertebrates. A summary of toxicity values for aquatic life published in the literature for permethrin is found in the Sprague RA. Permethrin's water solubility is low and exhibits a strong tendency to bind to soil particles. High amounts of suspended sediment may increase the bioavailability to aquatic organisms.

Nicotinoids. These insecticides include imidacloprid, a relatively new insecticide that acts on the central nervous system of insects, causing irreversible blockage of post synaptic nicotingergic acetylcholine receptors. Imidacloprid is proposed for use only in the form of the

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[7] Koc is a sorption coefficient that is often used to compare the relative mobility of different pesiticides. The higher the Koc value the more strongly the pesiticide is sorbed, and therefore the less mobile it is.

Imicide® product, a capsule implanted directly into a tree. Movement of imidacloprid is restricted to the vascular system of the tree and kills insects when they feed. The potential for imidacloprid to enter air, soil, or water is negligible when using Imicide® capsules.

Herbicides. Herbicides can impair the essential biological requirements of salmon if they undermine the physical, chemical, or biological processes that collectively support a productive aquatic ecosystem (Preston 2002). The alteration of watershed characteristics by herbicides can include: disruption of the growth of riparian deciduous vegetation, reduction of delivery of leaves and intermediate sized wood, and alteration of hydrologic and sediment delivery processes (Spence *et al.* 1996). Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the toxic effects of herbicides. The application of herbicides can affect the productivity of the stream by altering the composition of benthic algal communities, the food source of macro-invertebrates. Benthic algae are important primary producers in aquatic habitats, and are thought to be the principal source of energy in many mid-sized streams (Minshall, 1978; Vannote *et al.* 1980; Murphy, 1998). Herbicides can directly kill algal populations at acute levels or indirectly promote algal production by increasing solar radiation reaching streams by disruption of riparian vegetative growth. The disruption of riparian vegetative growth carries with it other adverse consequences for salmonid habitat, such as loss of shade, bank destabilization, and sediment control. Therefore, herbicides can potentially impact the structure of aquatic communities at concentrations that fall below the threshold for direct impairment in salmonids. The integrity of the aquatic food chain is an essential biological requirement for salmonids, and the possibility that herbicide applications will alter the productivity and watershed characteristics of streams and rivers exist.

Herbicides can cause significant shifts in the composition of benthic algal communities at concentrations in the low parts per billion (Hoagland *et al.* 1996). Moreover, based on the data available, herbicides have a high potential to elicit significant effects on aquatic microorganisms at environmentally relevant concentrations (DeLorenzo *et al.* 2001). In many cases, however, the acute sensitivities of algal species to herbicides are not known. In addition, Hoagland *et al.* (1996) identify key uncertainties in the following areas: (1) The importance of environmental modifying factors such as light, temperature, pH, and nutrients; (2) interactive effects of herbicides where they occur as mixtures; (3) indirect community-level effects; (4) specific modes of action; (5) mechanisms of community and species recovery; and (6) mechanisms of tolerance by some taxa to some chemicals. Herbicide applications have the potential to impair autochthonous production and, by extension, undermine the trophic support for stream ecosystems.

Glyphosate. Glyphosate, an amino acid derivative, is a broad-spectrum, non-selective systemic herbicide. It is absorbed by leaves, moves rapidly through the plant, and acts to prevent production of an essential amino acid that inhibits plant growth. Glyphosate is slightly toxic to fish, and practically non-toxic to aquatic invertebrate animals (USDA 2001). However, the presence of inert ingredients may exacerbate its toxicity. A summary of toxicity values for aquatic life published in the literature for glyphosate is found in the Sprague RA. Glyphosate is strongly adsorbed to most soils, and dissolves easily in water. Glyphosate remains unchanged in

the soil for varying lengths of time, depending on soil texture and organic matter content. The half-life of glyphosate can range from 3 to 130 days (USDA 2001). Soil microorganisms eventually break down glyphosate and the potential for leaching is low due to the soil adsorption. Although glyphosate has a low propensity for leaching, it can enter waterbodies by other means, such as overspray, drift, or erosion of contaminated soil (EPA 1993). Once in water, glyphosate is strongly adsorbed to any suspended organic or mineral matter and is then broken down primarily by microbes.

The toxicity of glyphosate to aquatic species increases with increasing temperature and pH (SERA 2003a). In the aquatic environment with freshwater fish, toxicity appears to increase with increasing temperature and pH. As reported in the Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates (USFWS 1980), glyphosate was twice as toxic to rainbow trout at 17°Celsius than at 7°Celsius. With bluegills, toxicity was twice as toxic at 27c°Celsius compared to 17°Celsius. Toxicity was also two to four times greater to bluegills and rainbow trout at a pH level of 7.5 to 9.5 than at pH 6.5 (PH of 7.0 is considered 'neutral water'). However, the EPA (1993) states that glyphosate is stable at pH 3, 6, 9 at 5 and 35 Environmental Concentration.

Glyphosate acid and its salts are classified as 'moderately toxic' pesticides by the EPA. Technical glyphosate acid (parent pesticide) is 'practically nontoxic' to fish and may be "slightly toxic" to aquatic invertebrates. The 96-hour LC50 is 86-140 milligrams per litre (mg/L) in rainbow trout and 120 mg/L in bluegill sunfish. The 48-hour LC50 for glyphosate in daphnia (water flea), an important food source for freshwater fish, is 780 mg/L. The results of a rainbow trout yolk-sac 96-hour LC50 static bioassay yielded results at the 3.4 mg/L level.[8]

There is a very low potential for the pesticide to build up in the tissues of aquatic invertebrates or other aquatic organisms.[9] In one study of bioaccumulation and persistence, glyphosate was applied to two hardwood communities in Oregon coastal forest and none of the 10 coho salmon fingerlings analyzed had detectable levels of the herbicide or its metabolite aminomethylphosphonic acid, although levels were detectable in streamwater for three days and in sediment throughout the 55-day monitoring period.[10]

Dicamba. Dicamba is a member of the benzoic acid chemical family. Benzoic acid herbicides are similar in mode of action and structure to the phenoxy herbicides, such as 2,4-D. Like phenoxy herbicides, dicamba mimics a plant growth hormone, affecting cell division (Cox 1994). Study results in aquatic organism toxicity have yielded varying results. Dicamba is slightly toxic to fish and may be toxic to aquatic macroinvertebrates (SERA 1999). A summary of toxicity values for aquatic life published in the literature for dicamba is found in the Sprague

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[8] USGS acute toxicity website: http://www.cerc.usgs.gov/data/acute/acute.html

[9] Extoxnet website: http://extoxnet.orst.edu/

[10] Toxnet website: http://toxnet.nlm.nih.gov

RA. Dicamba is moderately persistent in soil and highly mobile in soil. Half-lives vary significantly, from one to six weeks (EPA 1983), with the typical half-life being four weeks (Weed Sci Soc Amer 1983). When applying dicamba, exposure to non-target species may be difficult to control due to its high volatility (SERA 1999).

Dicamba is categorized by the EPA as 'slightly toxic' to fish, and 'practically non-toxic' to aquatic organisms. The LC50 (96-hour) for technical dicamba is 135 mg/L in rainbow trout (*O. mykiss*) and bluegill sunfish (*Lepomis microchirus*). The LC50 (48-hour) for dicamba is 35 mg/L in rainbow trout (USDA 2001). It is important to note that although dicamba is 'slightly toxic' to fish, there are variations in study results with reference to salmonids. One study found that there were no effects on yearling coho salmon at concentrations up to 100 parts per million (ppm). However, yearling coho were killed by much smaller doses (0.25 ppm) during a seawater challenge test that simulated their migration from river to ocean (Cox 1994). Little is known about sublethal effects on fish.

Dicamba does not bind to soil particles. Microbes appear to be the primary source of chemical breakdown the soil. In sterilized soil, over 90% of applied dicamba was recovered after four weeks, suggesting that microbes were responsible for the decomposition.[11] Sunlight does not appear to play a major role in breakdown, as with many other herbicides. Volatilization (vaporization) of dicamba from soil surfaces may not be an important process, although some volatilization can occur from plant surfaces. The principal soil metabolite appears to be 3,6-dichlorosalicylic acid.

Picloram. Picloram is a pyridine carboxylic acid herbicide that acts as a plant growth regulator (SERA 2003c). It is absorbed by the plant roots, leaves and barks. It moves both up and down within the plant, and accumulates in new growth, interfering with the plant's ability to make proteins and nucleic acids. It is moderately toxic to fish and slightly toxic to aquatic invertebrates. Picloram is highly soluble in water, resistant to biotic and abiotic degradation processes, and degrades very slowly with half-lives ranging from 167 to 513 days (EPA 1995). Its major route of dissipation appears to be leaching. Given its high persistence, it appears unlikely that picloram will degrade once it reaches ground water, even over a period of several years (EPA 1995). While not as toxic as other the chemicals examined in this consultation, the environmental fate characteristics of picloram may ensure introduction into coho habitat and subsequent exposure.

Fungicides. Chlorothalonil is a member of the polychlorinated benzene carbonitrile fungicide class of pesticides. This chemical is toxicologically dissimilar to existing chemical substances currently used at Sprague and is not expected to share a common mechanism of activity. The results of the 96-hour acute toxicity studies indicate that chlorothalonil is very highly toxic to fish and aquatic macroinvertebrates (EPA 1999). A summary of toxicity values for aquatic life published in the literature for chlorothalonil is found in the Sprague RA. There is

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[11] Toxnet website: http://toxnet.nlm.nih.gov

a lack of data on the effects on early life stages, sublethal behavioral effects or environmental influences on toxicity.

Chlorothalonil is almost non-soluble in water, not generally been considered a highly mobile pesticide, and is more likely to be found in runoff from treated areas. The persistence of chlorothalonil varies with environmental conditions and is resistant to hydrolysis, photolysis, and volatilization, and only moderately susceptible to degradation in soil under aerobic conditions (EPA 1999). Chlorothalonil can contaminate surface water via spray drift or through runoff and erosion. Chlorothalonil in the soil under aerobic conditions degrades to SDS-3701. SDS-3701 appears to be more persistent, mobile, and available for runoff for longer periods than chlorothalonil. However, studies have shown that SDS-3701 is significantly less toxic than parent chlorothalonil (EPA 1999).

Adjuvants. Numerous adjuvants, solvents, and other 'inert' ingredients are also contained in pesticide formulations, many of which are toxic to aquatic species (Stark and Walthall, 2003), and consequently are also applied in the watersheds. Frequently used adjuvants include surfactants such as nonylphenol polyethoxylates, alkylbenzene sulfonate, polyethoxylated alkyl amines, and others. Toxic solvents include kerosene, naphthalene, cyclohexanone, ethylbenzene, xylene, a variety of oils, and other pesticides. Inert ingredients are generally inclusive of adjuvants and solvents, but may include other additives as well. The proprietary nature of many pesticide formulations can make analyzing pesticide formulation toxicity mechanisms difficult due to undisclosed ingredients. In addition, in some cases, the pesticide active ingredient may be less toxic to aquatic species than the 'inert' ingredients.

Adjuvants include the following:

1. Surfactants (surface-active ingredients). These are substances that improve the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids. Surfactants include emulsifying agents, crop oils, concentrates, and stickers.
2. Emulsifying Agents. An emulsion is a mixture of two incompletely mixed liquids, one which is dispersed in the other. Emulsifying agents work to promote the suspension of one liquid in the other. In herbicides, there are two types of emulsions: "Oil-in-water" emulsion, in which the spray mixture is similar to water, and "water-in-oil" emulsion, a rather viscous spray, also called "invert" emulsions. The "oil-in-water" emulsions are widely used in the formulation of herbicides to aid in getting an oil-soluble herbicide dispersed in a water mixture so that the active ingredient may be applied as a water spray. Inert emulsions are used to aid in drift control, to improve resistance of the herbicide treatment to the effects of weather (rain), to improve accuracy of delivery of the herbicide, and to enhance herbicide activity.
3. Wetting Agents (spreaders). Spreaders are added to decrease surface tension in a mixture and cause a larger portion of each spray droplet to come in contact with surface of the vegetation. The goal is to increase coverage and effectiveness, although it may also alter herbicide selectivity. There are four spreader types: (1) Anionic, which has an electrical charge in water; (2) cationic, which has an electrical charge in water; (3) nonionic, which

does not have an overall electrical charge; and (4) amphoteric, which has positive or negative charges, depending on the pH of the solution.

4. Drift Control Agents. Drift of herbicide sprays can be a problem in some environments. One way to reduce herbicide drift is to increase the droplet size of the spray. Adjuvants that are used to control drift do so, in part, by reducing the number of fine spray droplets. Thickeners may be used as drift control agents.
5. Crop Oil Concentrates. These are products that contain 80-85% petroleum or vegetable oil and 14-20% surfactant and emulsifiers. An "emulsifiable oil", on the other hand, is a product that contains 98% oil and 1-2% emulsifiers. This group is also called "nonphytotoxic oils" and 'phytobland oils.'
6. Stickers. These are adjuvants that cause herbicide to stick to foliage and prevent runoff from target vegetation. The desired result is increased effectiveness.
7. Compatibility Agents. These are adjuvants that aid in the suspension of herbicides when they are combined with other pesticides or fertilizers. Used primarily when the carrier solution is a liquid fertilizer.
8. Acidifiers and Buffers. Acidifiers are acids that neutralize alkaline solutions and lower pH when added to herbicide, while buffers can change the pH to a certain level and maintain it, even if the alkalinity changes.
9. Antifoaming Agents and Spray Colorants. Defoaming agents and dyes.

Specific Inert Ingredients Known to be Present in Products Proposed for Use.

Cyclohexanone. Cyclohexanone is present in the Digon® 400 formulation of dimethoate.

Ethylbenzene. Present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin. This inert ingredient is most commonly found in vapor form since it moves easily into the air from water and soil. In the air, ethylbenzene is broken down by sunlight in approximately 3 days. In surface water, it breaks down by reacting with other pesticides. In soils, ethylbenzene is broken down by bacteria.

Light aromatic solvent naphtha. Present in the Pounce® 3.2 EC formulation of permethrin. Light aromatic solvent naphtha is slightly toxic to terrestrial species, as illustrated by the data summarized in the RA.

Petroleum distillates. Present in the Digon® 400 formulation of dimethoate.

Xylene. Present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin. The inert ingredient xylene very quickly evaporates into the air from surface water and soil where it may remain for several days until it is broken down by sunlight. Because xylene is applied as a liquid, it does have the potential to infiltrate into the soil. Most xylene insurance water evaporates into the air in less than a day. Xylene is more persistent in ground water where evaporation is impaired.

In some cases, the pesticide active ingredient may be less toxic to aquatic species than the 'inert' ingredients. The herbicide glyphosate provides a classic example. The LC50 values for rainbow trout range for technical grade glyphosate range from 86 mg/L to 140 mg/L (EPA, 1993). However, LC50 values for rainbow trout to glyposate formulations range from 8.2 mg/L to >1000 mg/L (EPA 1993), depending on the adjuvants and surfactants added.

Herbicide mobility in soil can be increased by the use of surfactants, but effects to mobility are unlikely due to the relatively low concentration of surfactants in the soil/water matrix at Forest Service application rates (Bakke 2002) which are comparable to BLM application rates. In general, it appears that aquatic species are more susceptible to adverse effects from surfactants than terrestrial species. At least some of the aquatic sensitivity to surfactants is due to irritation of gill membranes and alteration of their permeability and molecular exchange properties.

Impurities may also pose risks for aquatic species. Hexachlorobenzene, classified as a human carcinogen, is an impurity in picloram (SERA 2003). Hexaclorobenzene is ubiquitous and persistent in the environment. Under typical application scenarios, it volatilizes from the soil or vegetation surface, but can bioconcentrate in fish if it reaches aquatic habitats. Hexachlorobenzene can contaminate water by runoff or volatilization and deposition in rainwater. Because hexachlorobenzene binds tightly to soil, it is not likely to percolate through soil to contaminate groundwater.

Effects of IPM Implementation

Chemical use within the proposed IPM program is reasonably likely to result in sublethal adverse effects to ESA-listed salmonids within the action area. Within the past several years, the following studies documented that significant sublethal effects to salmonids can result from exposure to pesticides and other toxic pesticides. Sandahl *et al.* (2004) documented that chlorpyrifos (an organophosphate insecticide) and copper (a metal) both caused loss of olfactory sensory function in juvenile coho salmon at environmentally relevant concentrations. A 20% reduction in olfactory sensory function occurred at 4.4 µg/l for copper and 0.72 µg/l for chlorpyrifos. In addition, Sandahl *et al.* (2004) demonstrated that a concentration of 0.2 µg/l of the insecticide esfenvalerate evoked distinct and irregular bursts of postsynaptic activity in the olfactory bulb of juvenile coho salmon. These effects could interfere with olfactory mediated behaviors that are important for the survival and migration of salmonids.

Scholz *et al.* (2000) documented sublethal behavioral effects in Chinook salmon from the insecticide diazinon at concentrations as low as 1.0 µg/l. Since the behavioral effects observed by Scholz *et al.* included inhibition of predator avoidance, the 'sublethal' exposure could ultimately result in death. Accurate assessment and understanding of sublethal effect thresholds are further complicated by allostatic loading, as described by McEwen and Wingfield (2003). Briefly, allostatic loading results when organisms are exposed to multiple stressors during their life cycle that reduce the chance of reproductive stress.

Receiving waterways which support listed fish may already be degraded from non-BLM pesticides, herbicides or fertilizers applications. As stated in the BA and described in section 2.1.4 of this Opinion, land uses within Jump-off Joe Creek include agricultural, private timber, and suburban use. As such, Jump-off Joe Creek very likely has various concentrations of pesticides, herbicides, and fertilizers in the water column and sediments, and elevated water temperatures during certain portions of the year. The risk of adverse effects increase when BLM pesticide, herbicide, or fertilizer runoff is added to waterways that may have concentrations from concurrent runoff or drift. Given the results of the studies discussed above and the emerging understanding of the risks of allostatic loading, the pesticides in the proposed action (including other organophosphates and pyrethroids) have the potential for significant low-dose sublethal effects.

Further, in a study of environmental contaminants on behavior, Weis *et al.* (2001) stated: "It is assumed that effects at the molecular and cellular levels precede detectable effects at the individual organism level, which precede effects at the population and community level." As evidence, Weis (2001) found that neurotoxic effects at the biochemical level altered the predator-prey behavior of the mummichog, (*Fundulus heteroclitus*) which then had consequences that were in clear connection on the population and community structure such as reduced growth and condition. Pollution exposure, whether it be from elevated pesticide concentrations or more conventional impacts such as anoxia or high temperature, may also lead to reduced growth rates and infection for juvenile salmonids but even these responses are preceded in time by effects at the molecular level and can have connections to the population and community level.

Most adverse effects from the chemical portion of the IPM plan are likely to be sublethal, which can be further divided into narcosis and rheotropism. Sublethal or nonlethal endpoints do not require that mortality be absent; rather, they indicate that death is not the primary toxic endpoint being examined. Rand (1995) states that the most common sublethal endpoints in aquatic organisms are behavioral (*e.g.*, swimming, feeding, attraction-avoidance, and predator-prey interactions), physiological (*e.g.*, growth, reproduction, and development), biochemical (*e.g.*, blood enzyme and ion levels), and histological changes (*e.g.*, degenerative necrosis of the liver, kidneys, and gill lamellae; Lorz *et al.* 1979). Some sublethal effects may indirectly result in mortality. Changes in certain behaviors, such as swimming or olfactory responses, may diminish the ability of the salmonids to find food or escape from predators and may ultimately result in death. Some sublethal effects may have little or no long-term consequences to the fish because they are rapidly reversible or diminish and cease with time. Individual fish may exhibit different responses to the same concentration of toxicant. The individual condition of the fish can significantly influence the outcome of the toxicant exposure. Fish with greater energy stores will be better able to survive a temporary decline in foraging ability, or have sufficient metabolic stores to swim to areas with better environmental conditions. Fish that are already stressed are more susceptible to the deleterious effects of contaminants, and may succumb to toxicant levels that are considered sublethal to a healthy fish.

Narcosis and rheotropism, discussed further below, are two types of sublethal effects that compromise salmonids ability to migrate, feed, and seek refuge from predators. In some

instances, sublethal effects such as reduced predator avoidance, may indirectly result in injury or mortality to ESA-listed salminds, through increased predation.

Sublethal Effect - Narcosis. When exposed to elevated concentrations of polar and nonpolar organic pesticides, fish can become narcotized. Narcosis is a generalized nonselective toxicity response that is the result of a general disruption of cell membrane function. The process of narcosis is poorly understood, but is thought to involve either a 'critical volume' change in cellular membranes due to the toxicant dissolving into the lipid membrane and altering its function, or by the 'protein binding' process in which hydrophobic portions of receptor proteins in the lipid membrane are bound by the toxicant molecules, thus changing the receptor protein's function (Rand 1995). A fish with narcosis is more susceptible to predation as a result of a loss of equilibrium, a reduction in swimming ability or a lack of predator avoidance behavior. Furthermore, a fish with narcosis also has difficulty maintaining its position in the water column, and can be carried by water currents into areas of sub-optimal water quality.

Sublethal Effect - Rheotropism. Rheotropism refers to fish behavior in a current of water, either directly as a response to water flowing over the body surface or indirectly as a response to the visual, tactile or inertial stimuli resulting from the displacement of fish in space (Dodson and Mayfield 1979). Several studies involving the herbicide 2, 4-D (which is not proposed for use in the IPM) provide example's of rheotropism. Folmar (1976) used rainbow trout fry in an investigation to determine whether fish avoided water contaminated by 2, 4 D. At concentrations of 1.0 or 10.0 mg/L of 2,4-D, there was significant avoidance of the chemical. Similarly, Dodson and Mayfield (1979) assessed the effect of 2,4-D on the reotaxic response (the tendency to swim upstream to compensate for flowing water) of rainbow trout. The report stated that, at 'realistic concentrations' of 2,4-D in water, there would be a tendency for fish to be moved downstream because of a reduced reotaxic response.

Chemical Interactions and Mixture Toxicity. Rand (1995) states that in 'assessing chemically induced effects (responses), it is important to consider that in the natural aquatic environment organisms may be exposed not to a single chemical but rather to a myriad or mixture of different substances at the same or nearly the same time. Exposures to mixtures may result in toxicological interactions.' A toxicological interaction is one in which exposure to two or more chemical residues results in a biological response quantitatively or qualitatively different from that expected from the action of each chemical alone. Exposure to two or more chemicals simultaneously may produce a response that is simply additive of the individual responses or one that is greater (synergistic) or less (antagonistic) than expected from the addition of their individual responses. Application of pesticides within the IPM is likely to contribute to elevated toxicological responses caused by other sources of chemical pesticides within the action area. The temporal and spatial variability of the composition of mixtures, along with local water quality parameters, makes understanding and predicting relative effects a complex and challenging task. Furthermore, sublethal effects, which by nature are less apparent than lethality, have rarely been studied in conjunction with exposure to chemical mixtures (Kraak *et al.* 1994 as cited in Forget *et al.,* 1999).

Given the proposed five-year implementation of the IPM plan and the number of herbicides and pesticides and application events, many discreet variables will influence relative effects (*i.e.*, exposure) to ESA-listed salmonids. Variables range from weather (wind/rain/temperature/humidity), the fate characteristics of the pesticide, herbicide or fertilizers, implementation of CPs, the particular application area's topography and composition of the nearest waterway buffer, the lifestage of the salmonid, relative water quality, and background concentrations from non-BLM applications. The pathways of potential exposure to ESA-listed salmonids and their prey base can be from waterborne delivery, either through overland flow or subsurface flow, or through airborne drift soon after application.

To explore the likelihood/magnitude of exposure from individual applications, the BLM addressed predicted effects from the standpoint of the lowest observable effects level from individual pesticides, herbicides and fertilizers. The BLM incorporated several models to conduct this analysis. Drift was modeled through the Agricultural Drift (AgDRIFT) model and runoff was predicted using the GLEAMS and MOC models. The use of models to predict environmental concentrations resulting from pesticide, herbicide and fertilizer use is complicated by the wide range variables described above. To simplify the task, the BLM incorporated a limited number of application scenarios based on anticipated operations and circumstances. While the scenarios chosen in the RA are intended for use in predicting expected conditions, a conservative bias or worst possible case scenario was incorporated when assumptions were required. General model assumptions are discussed below, and discussed in more detail further within this analysis:

The GLEAMS model was used to predict runoff of chemicals and water as they might be measured at the edge of each orchard unit. However, the Sprague units generally have significant areas of untreated field edges and well-vegetated buffers between treated acreage and receiving streams. These untreated intervening areas, collectively termed 'buffer zones,' are expected to have a significant effect in reducing the amount of chemicals that actually reach streamwater. To account for the attenuating effect of buffer zones, the MOC model was set up to represent steady saturated shallow subsurface flow across a minimum 30-foot buffer zone. The fate and transport modeling assumptions used in the RA correspond to the pesticide application details of (Maximum Production IPM), and that the proposed action (Alternative B, IPM with Environmental Protection Emphasis) actually contains additional limitations on certain aspects of chemical pesticide and fertilizer use to provide added protection to human health and the environment.

The proposed action was developed based on the results of the RA. These limitations, such as the use of wider buffers for certain pesticide application methods, provide additional protection against the possibility of adverse effects to listed fish species.

The BLM used the Quotient Method (EPA 1986) in their BA to evaluate risk to aquatic organisms and threatened salmonids. However, the method is based on lethal response and assumes that the dose/response curve resembles a typical curve produced from a toxicological model presented in the 1975 Regulations for the Enforcement of the Federal Insecticide,

Fungicide, and Rodenticide Act (40 C.F.R. 154). Furthermore, the EPA (1986) states that the procedure does not indicate the 'probability of adverse effects,' and that they 'view the risk of criteria with their safety factors as 'rough' estimates of potential risk to non-target species.' Similarly, NMFS does not currently recognize this method as being sufficiently protective of ESA-listed species. In the context of this consultation and given the lack of more specific information to the contrary, NMFS considers the $1/20^{th}$ value procedure as a conservation measure that attempts to minimize, though not avoid, lethal or sublethal effects in coho salmon. NMFS has used the $1/20^{th}$ value in conjunction with the LC50 value and the most conservative sublethal effect concentration available in the literature to assist in evaluating the effects of the proposed action.

For sublethal effects, the lowest observed effect concentration (LOEC) from each of the three assessment endpoints was selected for the risk evaluation. The selected LOECs are intended to be the most conservative, representative estimates available for adverse effects at all life-stages related to survival, migration, or reproduction. The estimated pesticide concentration over the sublethal effect level was defined as an effects ratio. Risks to survival, migratory, and reproductive endpoints were determined to be low if the effects ratio was 0.1 or below, moderate if 0.1 to 1.0, and high if 1.0 or greater.

While these modeling assumptions conservative, model result just express output concentrations from single applications that do not account for potential multiple exposures to listed fish and to their supporting ecosystems. There is potential for multiple exposures to single or combined pesticides, herbicides and fertilizers from the proposed multi-year, multi-location BLM applications that may be delivered to non-target aquatic habitats, particularly during fall and spring runoff events. Potential non-target runoff areas support each of the ESA-listed salmonid life history stages. While the BLM effects analysis and methodology is conservative, the issue of potentiation, such as additivity or synergism, from repeated exposure to the same pesticides, herbicides or fertilizers or from exposure to mixtures are likely to result in adverse effects to ESA-listed salmonids.

The risk of adverse effects increase when BLM produced pesticide, herbicide, or fertilizer runoff is added to waterways that are already contaminated. The BA indicates that receiving waterways with listed fish also have elevated temperatures during certain periods of the year. Studies have demonstrated that elevated temperatures may increase the susceptibility of listed fish or their prey base to small concentrations of pesticides, herbicides or fertilizers (Folmar et al. 1979; Woodward 1976; Kumaraguru and Beamish 1986).

For the purpose of this analysis, the calendar year has been divided into three general zones of exposure risk to ESA-listed salmonids from the proposed action, as depicted in Figure 2. Through these three zones, the precipitation and number and type of pesticide, herbicide and fertilizer applications determine the relative risk to ESA-listed salmonids.

Figure 2. Timing of Listed Species by Lifestage and Annual Precipitation - Sprague

Corresponding to Figure 2, the precipitation and lifestages and relative risk of exposure has been summarized in Table 6.

Table 6. Precipitation, Lifestage, and Application/Delivery Risk to SONC coho salmon

Zone One (January through April)	**Precipitation ranges from 5 - 2 inches per month. 48% of annual precipitation occurs in this period.**
Coho Lifestage(s)	Adults (generally January only), incubating eggs (alevin) and newly-emerged fry, as well as juveniles up to 1.5 years old.
Applications and delivery risk:	Most BLM applications would occur during the latter stages (March and April) of zone one as the growing season arrives.
Zone Two (May through September)	**Ranges from just over 1 inch to less than half an inch per month. 11% of the annual precipitation occurs in this period.**
Coho Lifestage(s)	Rearing juveniles throughout and adults beginning to show up in September.
Applications and delivery risk:	Zone two generally encompasses the most risk from insect pest as well as the vegetation growing season, thus the majority of BLM applications are proposed to occur within zone two. Precipitation is generally readily predictable in this season, and only approximately. Since most BLM pesticide applications will occur within this time-frame, the greatest potential for accumulation of pesticides on orchard grounds exist.
Zone Three (October through December):	**Precipitation rises from 2 inches to over 5 per month. 41% of the annual precipitation occurs in this period.**
Coho Lifestage(s)	All lifestages are present during this zone.
Applications and delivery risk:	Most BLM applications would occur during the beginning of this zone, though there may be several applications (over the five year term) in each month. The increase in precipitation during this zone could deliver pesticides that have accumulated (but not yet delivered to aquatic systems) on orchard grounds from zone one, and particularly zone two through runoff and subsurface flow pathways.

Factors of Uncertainty. Predicting exposure levels or effects from specific exposure levels is difficult because of the uncertainty inherent in the tools used to conduct effects analyses. Sources of analytical tool uncertainty are lack of information regarding laboratory to field extrapolation, mixture effects, toxicity and behavior of degradation/metabolic products, use of physiologically/ecologically relevant endpoints based on the pesticide mechanism of action, and reliance on short-term toxicity tests. All of these sources of uncertainty fall into one or more of three basic categories: (1) Parameter uncertainty (measurement, sampling, and systematic errors); (2) modeling uncertainty (simplification of real world processes, model misuse, use of inappropriate surrogates); (3) and scenario uncertainty (descriptive, aggregation, and professional judgement errors).

Examples of sources of uncertainty associated with the proposed project are: (1) The fate of herbicides in streams; (2) modeling uncertainty; (3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; (4) the toxicity of pesticide mixtures; and (5) the

mitigating or exacerbating effects of local environmental conditions. Where appropriate, these and other uncertainties will be identified, and where uncertainties cannot be resolved using the best available scientific literature, the benefit of the doubt will be given to the threatened or endangered species in question.

Vectors of Exposure.

Waterborne Delivery. The BA indicated that there are three primary scenarios of how pesticides could reach the stream channel due to the proposed action:

1. Drift from chemical spray. This period of concern lasts for hours, usually until the chemical has been allowed to dry on foliar surfaces.
2. Runoff from the fields to which spray is applied. This period also lasts on the scale of several hours, during which time the rain flowing over foliar and soil surfaces collects the most available chemical residues (either dissolved or associated with fine particulate).
3. Potential spills in and near stream channels. Spills are instantaneous loads of pesticide delivery directly into the water.

These scenarios have the potential to transport chemicals to adjacent drainages and waterways which ESA-listed salmonids occupy for migration, rearing, and spawning. Large amounts of precipitation which expands the ephemeral stream system can result in flowing water coming into contact with pesticide deposits (Norris 1980 as cited in Dent and Robben 2000). The adsorption potential, stability, solubility, and toxicity of a chemical determines the extent to which it will migrate and adversely effect surface waters and groundwater (Spence *et al.* 1996).

Chemical Drift. Drift occurring immediately after application is one way that exposure to non-target species may occur outside the application area. In evaluating drift effects to non-target species, the BLM modeled off-target pesticide drift from ground vehicle and hand methods of pesticide applications using AgDRIFT, a cooperative model developed by the EPA Office of Research, the USDA Agricultural Research Service, the USDA Forest Service, and the Spray Drift Task Force.

Ground vehicle and hand methods of pesticide applications could result in spray drift and volatilized chemicals. Data from field studies were used to characterize drift from applications using high-pressure hydraulic sprayers, hand-held wands, and backpack sprayers. For all applications, the highest of the deposition values predicted for all potentially treated areas was used as the input to the quantitative risk calculations. The AgDRIFT model was used to estimate off-target drift deposition from ground boom applications of the herbicides dicamba and glyphosate.

Drift is dependent on gravity, air movement, and droplet size.[12] Smaller droplets stay aloft longer and the longer a droplet is suspended the greater the potential for it to be translocated by air currents. A droplet size of 100 microns (mist) takes 11 seconds to fall 10 feet in still air. The same size droplet would travel 13.4 feet in a 1 mph wind while dropping that same 10 feet, and 77 feet at 5 mph. Application pressure, nozzle size, nozzle type, spray angle, and spray volume are all factors in determining droplet size. Droplet sizes increase with decreasing pressure and larger nozzle sizes. An indicated droplet size (*i.e.* 300 microns) actually represents a median diameter of all droplets. Actual droplet sizes will range from considerably smaller as well as larger than the indicated droplet size. During temperature inversions little vertical air mixing occurs and drift can translocate contaminates several miles. In addition, low relative humidity and/or high temperature conditions will increase evaporation and the potential for drift. Proposed buffers, application criteria, and concurrent drift monitoring reduce this risk.

Predicting environmental concentrations resulting from pesticide and fertilizer use at Sprague is complicated by the wide range of chemical, environmental, and operational assumptions. The modelers dealt with this uncertainty by choosing a limited number of scenarios based on anticipated operations and circumstances.

For all applications, the highest of the deposition values predicted for all potentially treated areas was used as the input to the quantitative risk calculations. No drift beyond buffer areas is expected from other ground application methods, based on the results of field studies summarized in the RA report.

Table 7 shows a comparison of the exposure profile data (estimated water concentrations from spray drift) specific to Jump-off Joe Creek, to stressor-response profile data (referenced LOECs) taken from attachment C of the BA to estimate the risk of adverse effects. The estimated surface water concentrations are extremely low, several orders of magnitude below the levels of concern. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs (see Sec 9.1 in Sprague RA).

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[12] NebGuide website at http://www.ianr.unl.edu/pubs/pesticides/g1001.htm

Table 7. RA-Modeled Stream Concentrations of Pesticides Under the Proposed Action Resulting from Application Drift, and Salmonid Effect Concentrations Selected by NMFS for Effects Evaluation

	Jump-off Joe Creek		Effect Concentration		
Pesticide *tractor-pulled rig with boom*	**Typ**	**Max**	**LOEC (mg/L)**	**Endpoint**	**REF**
Dicamba	1.65E-006	5.13E-006	1.8	mortality	Mayer and Ellersieck 1986
Glyphosate	2.47E-004	1.28E-006	0.046 (NOEC)	migration and growth	Morgan and Kiceniuk 1992

* Selected LOEC's are for various species of fish and might be less for aquatic macroinvertebrates (relevant to all tables)

** Numerical values represent scientific notation.

From the perspective of viewing each pesticide, herbicide and fertilizer application as a stand-alone event, the likelihood of direct adverse effects to SONC coho salmon from drift are remote. The attenuating effects of vegetative buffer zones, the conservative nature of the analysis, the ecological protection measures in place (as described within the proposed action), and the individual modeled concentrations lead to this conclusion.

However, this judgement is academic in nature; it is solely from the perspective of an individual pesticide application, with no contributing factors such as a degraded baseline or additive and synergistic effects from other chemicals. Further, though the use of models represent the best available technology for predicting drift concentrations, the variables that can determine exposure risk (*i.e.* weather) are likely to be highly variable over the five-year term of the proposed action. Given these factors, there is a reasonable likelihood that runoff concentrations will differ from those predicted and reasonably likely to lead to adverse effects.

Runoff. The chemical and physical properties of the pesticide such as solubility in water and affinity to soil particles help determine the rate and method of transport. Chemicals that adsorb well to the soil will tend to immobilized and be broken down in place as opposed to highly soluble chemicals that could be washed away via soil surface or subsurface movement with irrigation or rainwater, and will more likely be a potential contaminant. The soils at Sprague are generally well-drained, with slow to rapid runoff and moderate permeability, and low amounts of organic material.

The BA characterizes the Sprague as more similar to a well-forested watershed than an agricultural area due to the seed trees and well-managed surface vegetation. True overland flow is very rare in well-managed forests and, although runoff does reach streams, it is mostly via subsurface shallow flow. During rainfall events, true surface runoff normally occurs first from

streambanks, and then as the rain continues (and especially if it intensifies) from successively larger areas surrounding the streams.

Within the basin, pesticides are applied during irrigation season, and runoff of excess irrigation water from fields can transport them to surface water. Variations in temporal patterns of elevated pesticide concentrations can also be attributed to a seasonal rise in precipitation during the months of October through November. Significant rain events can increase erosion of soils with absorbed pesticides or flush of the more soluble pesticides. However, the climate at Sprague is characterized by fairly even precipitation with very few large, sudden rainfalls. This climate and the surface condition at the seed orchard are conducive to percolation rather than direct runoff of rainfall. Elevated concentrations of pesticides in Jump-off Joe Creek also have the potential to occur during irrigation season, which is generally from late May through September.

The BLM assessed runoff and leaching from the proposed action using the GLEAMS and the MOC models. GLEAMS will model the concentration of chemicals that will leave a target field, in this case an orchard block, that is transported by overland flow or that is adsorbed to soil particles transported in the flow by estimation of soil chemical concentrations, initial maximum runoff loadings, and long-term chemical loss in runoff, sediment, and soil below the root zone. The GLEAMS analysis included two scenarios: (1) Typical environmental characteristics and pesticide/fertilizer use; and (2) wet conditions and maximum pesticde/fertilizer use.

The model is not able to predict chemical concentrations reaching streams separated from the target fields by buffer areas. The Sprague units generally have untreated field edges and vegetated buffers between treated acreage and receiving streams. These untreated intervening areas (buffer zones) are expected to reduce the amount of chemicals that actually reaches streamwater. Buffer zones between treated acreage and receiving streams at Sprague will typically be in the range of 30 to 100 feet or more. These untreated intervening areas are expected reduce the amount of chemicals that actually reach streamwater. To account for the attenuating affect of buffer zones, the MOC model developed by the USGS was used. This is a two-dimensional groundwater flow and chemical transport mode that computes changes in concentration over time, accounting for the processes of dispersion, adsorption, and degradation.

The uncertainty in the GLEAMS model can be attributed to the model's sensitivity to input parameters that were not directly measured and had to be estimated based on available literature. These parameters include pesticide decay rates, foliar washoff, Koc, and soil curve numbers. The decay rates and foliar washoff factors govern the quantity of the contaminant available for movement, whereas the sorption coefficients and the runoff curve numbers govern the actual movement of the contaminants. Uncertainty in these parameters causes the majority of model uncertainty and exacerbates the risk from exposure.

Table 8 shows a comparison of the exposure profile data (estimated water concentrations from spray drift) specific to Jump-off Joe Creek, to stressor-response profile data taken from attachment C of the BA to estimate the risk of adverse effects. The estimated surface water

concentrations are extremely low, several orders of magnitude below the levels of concern. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs (Section 9.1 in Sprague RA).

In the maximum scenario, ammonia from runoff containing fertilizers was predicted to pose a risk to sensitive fish species in the main tributary to Jump-Off Joe Creek. No risks were predicted from typical conditions of use. From the perspective of viewing each pesticide application as a stand-alone event, the likelihood of direct adverse effects to coho from runoff and erosion are remote. The attenuating effects of vegetative buffer zones, the conservative nature of the analysis, the ecological protection measures in place (as described within the proposed action), and the individual modeled concentrations lead to this conclusion.

However, this judgement is academic in nature; it is solely from the perspective of an individual pesticide application, with no contributing factors such as a degraded baseline or additive and synergistic effects from other chemicals. Further, though the use of models represent the best available technology for predicting runoff concentrations, the variables that can determine exposure risk (*i.e.*, weather) are likely to be highly variable over the five-year term of the proposed action. Given these factors, there is a reasonable likelihood that concentrations will differ from those predicted and potentially lead to adverse effects.

No risks were predicted from typical conditions of use. From the perspective of viewing each application as a stand-alone event, the likelihood of direct adverse effects to coho from runoff and erosion are small. The attenuating effects of vegetative buffer zones, the conservative nature of the analysis, the conservation practices in place and the individual modeled concentrations lead to this conclusion. However, as for spray drift, this judgement is academic in nature; it is solely from the perspective of an individual pesticide application, with no contributing factors such as a degraded baseline or additive and synergistic effects from other chemicals. Further, though the use of models represent the best available technology for predicting runoff concentrations, the variables that can determine exposure risk (*i.e.* weather) are likely to be highly variable over the five-year term of the proposed action. Given these factors, there is a reasonable likelihood that concentrations will differ from those predicted and are reasonably likely to lead to adverse effects.

Table 8. RA-Modeled Stream Concentrations of Pesticides Under the Proposed Action Resulting from Runoff and Erosion, Effect Concentrations Selected by NMFS for Effects Evaluation

		Jump-off Joe Creek		Effect Concentration		
Pesticide		**Typ**	**Max**	**LOEC[1] (mg/L)**	**End-point**	**REF**
Hand-Held Ground Methods						
Chlorpyrifos		3.97E-010	8.96E-009	0.003	mortality	EPA 2000
Diazinon		-0-	1.25E-009	0.001	predation	Scholz *et al.* 2000
Esfenvalerate		1.76E-009	2.31E-009	2.50E-005	predation	Little *et al.* 1993
-Ethylbenzene		-0-	-0-	14	mortality	Mayer and Ellersieck 1986
- Xylene		-0-	-0-	0.1	rearing	Folmar 1976
Permethrin		2.03E-010	4.47E-010	7.5E-004	predation	Kumaraguru *et al.* 1982
-Ethylbenzene		-0-	4.33E-011	14	mortality	Mayer and Ellersieck 1986
-Light arom	solv naphtha	1.96E-009	1.15E-008	0.32	mortality	EPA 2001
-Xylene		-0-	-0-	0.1	rearing	Folmar 1976
Propargite		1.22E-011	1.71E-010	0.008	mortality	Uniroyal 1998
Chlorothalonil		3.14E-011	5.30E-010	0.0049	mortality	Caux *et al.* 1996
Glyphosate		1.80E-009	2.84E-008	0.046 (NOEC)	migration and growth	Morgan and Kiceniuk 1992
Tractor-pulled spreader (general fertilizers)						
NO3		9.57E-005	9.27E-005	2	mortality	Rouse *et al.* 1999
NH4		-0-	2.30E-003	0.0074	mortality	Knoph 1992

* Selected LOEC's are for various species of fish and might be less for aquatic macroinvertebrates (relevant to all tables)
** Numerical values represent scientific notation.

Accidental Spills. The RA addressed accidental spills of pesticides or fertilizer through the Exposure Analysis Modeling System (EXAMS) model. EXAMS was developed at EPA's Center for Exposure Assessment Modeling at Athens, GA (Burns 2000). Model inputs of half-lives and adsorption coefficients determined the rate and extent of transport of organic chemicals throughout three potential spill sites.

A separate EXAMS simulation was performed for each chemical and spill site. They include the mixing area near administrative buildings, orchard road that crosses the Lake Casso spillway near the south end of the lake, and the orchard road that crosses an intermittent stream near the southwest corner of orchard unit 53 (as referenced in the BA).

Results of the modeling show that maximum residues from spills into the larger perennial streams would reach the main tributary to Jump-off Joe Creek within an hour. These spills would take approximately three hours to reach maximum concentrations in the nearby portions of Jump-off Joe Creek. The likelihood of contaminant exposure from spills will be minimized through siting the mixing and loading zones in a designated chemical area away from water. These best management practices should avoid the scenario of spill delivery of pesticides to surface waters.

Sensitive species are at risk from a spill of esfenvalerate concentrate at the mixing area. Spills of tank mix directly into streams were predicted to pose risks to aquatic invertebrates and sensitive species from chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, and chlorothalonil.

For threatened and sensitive species known to be present in the Jump-off Joe Creek Watershed, concentrations were estimated in the tributary to Jump-off Joe Creek 0.2 miles south of the seed orchard, which is formed from the convergence of the three stream branches that drain and exit the southern side of the northwestern block of the orchard facility.

Elevated concentrations of pesticides from spill delivery that would result in exposure to SONC coho in Jump-off Joe Creek create the potential for lethal or sublethal effects. Spill mixtures may elicit synergistic or additive effects from the chemicals present in mixture themselves or from combinations of spill chemicals and degraded baseline concentrations.

Spills near any water will be avoided through siting the mixing and loading zones strategically in the pesticide area. These best management practices combined with an adequate spill prevention plan should avoid the scenario of spill delivery of pesticides to surface waters.

Summary of Vectors of Exposure. Site conditions at Sprague could lead to generally limited pathways of exposure to coho salmon. SONC coho, often at multiple lifestages, are expected to be downstream in Jump-off Joe Creek and the Rogue River throughout the year. In the event of a discharge to Jump-off Joe Creek, it is highly probable that coho will be in the vicinity of the exposure. However, given Sprague's upland location, discharges are very likely to be limited to runoff. The distance to coho use within Jump-off Joe (one mile), and the ground-based application methods would very likely preclude delivery from drift sources. However, drift delivery to onsite intermittent streams and subsequent delivery from surface or subsurface runoff could occur. In most instances, delivery of pesticides via subsurface, or overland flow, pathways would some time to become diluted or attenuate in concentrations.

Given Sprague's location, subsurface or surface water runoff and delivery to areas occupied by coho would likely be limited to spring (zone one) and fall (zone three) periods.

Accumulation of Pesticides, Herbicides, and Fertilizers in Soil. Impacts from the application of pesticides to soil can be divided into two groups - those occurring from chemicals which are highly mobile in soils and have a high water solubility, and impacts from chemicals with a low mobility in soil (high adsorption rate) and are only slightly soluble in water. High lipophilicity (fat solubility) of the pesticide is the primary driver for non-specific partitioning (sorption) into soil organics. True adsorption (binding to a specific site) also occurs, and positively charged pesticides tend to adsorb to clay particles (clays tend to have negative surface charges). Therefore, some pesticides with high water solubility can be adsorbed by soils with significant clay content.

Most chemicals proposed for application have a low mobility in soil due to a higher rate of adsorption. These chemicals would likely remain near the surface of the soil and degrade over time. Most degradation occurs by microbial metabolism. Other methods of degradation include hydrolysis (the splitting of a molecule by the addition of the elements of water), photolysis (degradation by radiant energy), and chemical degradation. Except the herbicide picloram which has a soil half-life in the five- to six-month range, the soil half-life of most of these chemicals is less than three months.

Three of the pesticides proposed for application at Sprague are highly mobile in soil - dimethoate, dicamba, and picloram. The RA predicted that none of these would leach into the groundwater in at Sprague. The application of the pesticides would not use a sufficient amount of water to move chemicals past the surface of the soil and the timing of the proposed pesticide considers forecasts for precipitation (an application rate of 50 to 150 gallons per acre of water mixed with the chemical would be equivalent to about 0.02 to 0.05 inches of water applied to the area). Any applied pesticides would likely remain near the surface and begin degrading, until subsequent rainfall or irrigation moves any remaining residues into the soil horizon. Mobile pesticides leaching through the soil column would migrate into groundwater. Photodegradation and metabolism by soil microbes would no longer be viable degradation pathways, and half-lives in groundwater could become substantially longer.

The GLEAMS modeling conducted for the RA indicates that negligible accumulation was expected. The long period of simulation (10 years with application assumed to occur annually) allowed an evaluation of the tendency for a chemical's environmental persistence, if residues remain after one year, to contribute to an increased concentration in runoff or leachate in later years. This conservative assumption is inherent in the stream concentrations estimated to result from any pesticide loss in runoff from treated areas.

Fertilizers. Fertilizers are used to optimize seed production in the seed orchards. Fertilizers are to be distributed over the ground using a broadcast spreader pulled by a truck or mounted on a tractor or ATV. There are five types of fertilizers proposed for use at Sprague: Ammonium sulfate, ammonium phosphate, ammonium nitrate, calcium nitrate, and potassium nitrate. Each of these fertilizers is very soluble in water and can contribute ammonia and nitrates in runoff to surface waters.

Ammonia in the runoff can exist in its ionized form (NH_4^+), and in its un-ionized form as ammonia (NH_3). The equilibrium between these two forms is largely dependent on pH and temperature. Un-ionized ammonia is the more toxic form, because it is a neutral molecule and thus is able to diffuse across the epithelial membranes of aquatic organisms much more readily than the charged ammonium ion (USEPA 1999). However, the ammonium ion is generally present in much greater concentrations and can also contribute to ammonia toxicity under some conditions. The RA modeling analysis assumed the most conservative situation and considered all of the ammonium in the runoff to be in the more toxic unionized form (NH_3).

Ammonia is of much concern due to its relatively toxic nature and its ubiquity in waterbodies. Ammonia occurs in natural waters secreted by aquatic plants and animals, and generated by heterotrophic bacteria as the primary end product of decomposition of organic matter (Randall and Tsui 2002). As aquatic plants and animals die, bacteria break down large protein molecules containing nitrogen into ammonia. Ammonia is then oxidized by specialized bacteria to form nitrites and nitrates.

Concentrations of ammonia acutely toxic to fishes may cause loss of equilibrium, hyper-excitability, increased breathing, cardiac output and oxygen uptake (USEPA 1986). In extreme cases, damage to the central nervous system from acute levels can lead to convulsions, coma, and death (Randal and Tsui 2002). Other mechanisms of ammonia toxicity were outlined by Ruffier *et al.*(1981) to include gill damage leading to suffocation, osmoregulation dysfunction (bloating) causing kidney failure, and inhibition of ammonia excretion leading to neurological and cytological failure.

At lower concentrations, ammonia has many sublethal effects on fishes, including a reduction in hatching success, increased respiratory distress, hormonal dysfunction, reduction in growth rate and morphological development (Rice and Bailey 1980; Soderberg *et al* 1983; USEPA 1986; USEPA 1999). The literature also contains some information concerning the effects that chronic exposure to low levels of ammonia can have on the structure and function of select tissues and organs such as gills, livers, and kidneys and their increased susceptibility to disease (Soderberg *et al* 1983; USEPA 1986; USEPA 1999). Behavioral effects to chronic levels of ammonia are reduced swimming stamina and performance which would affect predator avoidance and foraging behaviors (USEPA 1999).

The elevation of nitrogen in a stream has the potential to influence primary and secondary production altering the type and abundance of food available to salmonids. Nitrogen can promote the growth of periphyton, which in turn may influence the production of invertebrates and fishes (Spence *et al.* 1996).

Macro-invertebrates are reportedly less sensitive to ammonia than fish species (USEPA 1986). Flow-through tests determined that ammonia was acutely toxic to 19 freshwater macro-invertebrate species at concentrations ranging from 0.53 to 22.8 mg/L, whereas ammonia toxicity to 29 fish species ranges from 0.083 to 4.60 mg/L (USEPA 1986).

According to the BLM, the upper-bound scenario assumes maximum fertilizer application. Based on this modeling, BLM predicted to discharge of appreciable amounts of ammonia into Jump-off Joe Creek could carry a risk to SONC coho. While the RA modeling analysis correctly assumed the most conservative situation (saturated soils plus a large storm) and considered all of the ammonium in the runoff to be in the more toxic unionized form (NH_3). It is highly probable, considering the surrounding land use, that Jump-off Joe Creek and the Rogue River receive additional drift or runoff of fertilizers from other locations, and already contain an elevated concentration of ammonia from anthropogenic and natural sources. This cumulative burden may increase the risk and offset the conservative nature of the analysis.

The proposed action would preclude fertilizers within 50 feet of waterways as a measure to reduce delivery to aquatic systems. This distance would reduce runoff to surface water as the additional ground will sorb fertilizer compounds.

Temperature. Of the water quality actions assessed in this project, the combination of heat and other stress factors is most likely to compromise salmonid immune system function (Hardie *et al.* 1994; Kollner and Kotterba 2002; McCullough 1999). Likewise, exposure to environmental pollutants can decrease tolerance to temperature extremes (Paladino *et al.*, 1980). Subcellular and molecular changes such as enzyme induction are known to precede observable individual or population level effects (Boon *et al.*, 1992).

Elevated temperatures could exacerbate effects from pesticide discharges through mechanisms described above. As previously discussed, many factors contribute to elevated stream temperatures in waterways that host SONC coho salmon in the action area. As an example, glyphosate toxicity to rainbow trout increased with higher test temperatures (Folmar *et al.* 1979). Toxicity increased from pH 6.5 to 7.5, but did not change up to pH 9.5. Increasing temperature and pH with exposures to picloram resulted in greater toxicities to cutthroat trout and lake trout (Woodward 1976). Rainbow trout became more sensitive to permethrin with increasing water temperature (Kumaraguru and Beamish 1986). The 96-hour LC50 values decreased by nearly an order of magnitude (0.0064 to 0.00069 mg/L) between 10 and 20˚C, respectively.

Higher temperatures can also shift the equilibrium of ammonia species to its more toxic un-ionized form. The concentration of un-ionized ammonia present in an ammonia solution has been calculated to double in a 10˚C rise in temperature (Ruffier *et al.* 1981). While the effects of temperature on the mechanism of ammonia toxicity is not well understood, the increased bio-availability to the more toxic unionized ammonia can increase the risk of fertilizers to salmonids.

Mixture Toxicity. Aquatic organisms can be exposed to complex mixtures of contaminants resulting from pollution that originates from industrial, agricultural, and domestic land use. Eco-toxicological studies that assess the effects of contaminants to aquatic communities typically have been limited to assessing the impacts of individual toxicants only. However, discrete assessments of individual toxicants do not capture the true exposure routes and effects to species which occupy habitat that is subject to multiple temporal and spatial chemical discharge. For salmonids, who occupy diverse habitat types throughout each life

history stage, exposure to chemical mixtures can occur within the water column, and from contaminated sediments and food. Given these complexities, consideration must be given to the potential that a wide variety of chemicals might be simultaneously present in complex mixtures. Furthermore, these mixtures of chemicals likely contribute to reduced productivity of some aquatic ecosystems. For instance, Arkoosh *et al.*, (1991) found that juvenile Chinook salmon that migrated through waters contaminated with PCBs and PAHs, and heavily influenced by an urban landscape, bioacccumulated the pollutants, and showed signs of suppressed immune responses compared to uncontaminated fish. Casillas *et al.,* (1993) found that juvenile Chinook in urban waters showed suppressed immune function, reduced survival, and impaired growth as they migrated to the oceanic environment. More recently, a pilot study by the NWFSC revealed significant pre-spawn mortality of coho salmon within a highly urbanized watershed within the City of Seattle, as compared to a relatively non-urbanized stream within the Stillaguamish River Watershed. It is thought that pollutant mixtures delivered to the urbanized watershed through contaminated stormwater contributed to the high level of pre-spawn mortality, though the exact causes of mortality have not been fully determined to date.

Multiple chemicals that co-occur in aquatic systems may alter their toxicity by additive, antagonistic, or greater than additive (synergistic) effects (Denton *et al.* 2002). An additive effect occurs when the combined effect of several chemicals is equal to the sum of individual effects of each chemical as if they were alone (Klassen 1986). Antagonistic effect occurs when a mixture contains chemicals that interfere with each other's actions, or with the action of the other chemical. A greater than additive (synergistic) effect occurs when the combined effect of two chemicals is much greater than the sum of the effect of each agent individually (Klassen 1986). A special form of synergism is potentiation, which occurs when one substance has no toxic effect in and of itself, but when added to another chemical it enhances the toxicity of the toxic component (Klassen 1986).

Predicting Mixture Toxicity. It is necessary to examine the interactions or non-interactions of toxicants when characterizing and predicting the risk of chemical mixtures to ESA-listed salmonids. Predictive assessments of the aquatic toxicity of chemical mixtures are represented by numerous methods and models that are presented in several fields of pharmacology and toxicology (Faust 2003). In essence, however, there are two different fundamental hypotheses on the functional relationship between the toxicity of single substances and those of combined toxicants (Faust 2003). Commonly, those hypotheses are called concentration addition and response addition.

The concentration addition model best describes the scenario of non-interactive, joint-action and is generally applied to chemicals that exhibit a similar mode of action. The individual components of a mixture act independently but produce the same or similar effects and can be expressed in terms of the other (Broderius *et al.* 1995). For example, the joint toxicity of diazinon and chlorpyrifos on *Ceriodaphnia dubia* was examined in a study by Bailey *et al.* (1997). The toxic interaction was evaluated by a Toxic Unit approach that compared the LC50 estimates associated with the mixtures with the LC50s of the individual pesticides when tested alone. The results suggested that diazinon and chloryprifos exert additive toxicity to

Ceriodaphnia dubia. This is entirely reasonable given that both are metabolically activated organophosphorus pesticides and act similarly with respect to the inhibition of acetlycholinesterase (Bailey *et al.* 1997). The toxicity of s-triazine mixtures, herbicides that commonly interfere with photosynthetic electron transport, are found to also be accurately predicted by the concept of concentration addition (Faust *et al.* 2001). The study further demonstrated that low concentrations of individual triazines, that alone did not cause a statistically significant response, contribute predictably to the overall effects of multi-component mixtures. For an assessment of mixtures which have a common specific mechanism of action, these studies show that an assessment of mixtures solely by independent components can tend to underestimate its overall toxicity.

As an alternative concept to concentration addition, mixtures of chemicals composed of dissimilar toxicants with varying modes of action, can be analyzed via the response-addition model, for predicting toxicity (Faust 2001). These models are based on the assumption that each toxicant neither enhances or interferes with the other and contributes to a common response only if the concentrations of both substances exceed their respective thresholds (Broderius *et al.* 1995). In this case, the toxicity of a mixture is equal to the that of its most toxic component (Sharma *et al.* 1999) and that the relative effect of a toxicant remains unchanged in the presence of another chemical (Faust *et al.* 2001). This approach has been demonstrated to provide accurate predictions of single species toxicity when all underlying assumptions are fulfilled.

Faust *et al.* (2003) studied the situation of multiple exposures to biocides with strictly different specific mechanisms of action to freshwater algae. Both concepts of concentration addition and response addition was applied to predict mixture toxicity. The concentration addition approach tended to overestimate mixture toxicity showing that the response addition approach proved to be superior when mixture components are well known to interact specifically with different molecular target sites.

However, developing scientific research indicates that simple concentration addition and response addition models are not always good predictors of the toxicity of mixtures. In many cases the effects of mixtures cannot be predicted from single components. Pape-Lindstrom and Lydy (1997) demonstrated that the response addition model does not always accurately predict the mixture toxicity of chemicals with dissimilar modes of action. In their experimental design, larvae of the aquatic midge (*Chironomus tendons*) were exposed to binary combinations of atrazine and various organophosphate insecticides. Their results conclusively show a greater than additive response for several combinations of chemicals that have dissimilar modes of action. Mixtures that result in greater than additive (synergistic) toxicity are of much concern due to unpredictability based on the effect of individual components (Woods *et al.* 2002).

The complex interactions that result from a mixture are generally between the chemicals and the physiological systems within the body, rather than between the chemicals themselves (Marking 1985). Examples of such interactions are the alteration of the absorption, distribution, biotransformation, or excretion of one chemical by another. There are two currently recognized mechanisms of greater than additive (synergistic) toxicity that involve such interactions, the

increase in enzymatic activation of the other pesticide and the inhibition of enzymes responsible for detoxification (Woods *et al.* 2002).

In the metabolism of an organic pesticide, enzymatic activity induces a series of chemical alterations, in a process called biotransformation. The process of biotransformation can be divided into 'phase I' and 'phase II' metabolism. The first involves a change in the molecular structure of a pesticide by involving either hydrolysis, oxidation, or reduction (Sipes and Gandolfi 1986). Phase II biotransformation involves the conjugation of a substrate to endogenous pesticides (Boon *et al.* 1992). The end result of these reactions is that the metabolites are chemically distinct from their parent pesticide. Metabolites are usually more hydrophilic than their parent pesticide which restricts the partitioning of metabolites into cellular membranes, decreases reabsorption and facilitates eventual elimination (Sipes and Gandolfi 1986). The ease of which pesticides are eliminated depends on their water solubility. This explains why lipophilic pesticides, like dioxins, are readily absorbed, poorly excreted, and have a tendency to accumulate.

However, it is important to note that biotransformation can result in higher toxicity (Boon *et al.* 1992). For example, several organophosphorus insecticides such as chlorpyrifos, methyl-parathion, and malathion are in of themselves poor inhibitors of acetylcholinesterase. However, upon phase I metabolic conversion, their corresponding oxygen analogs are highly potent acetylcholinesterase inhibitors. The rate of metabolic activation to a pesticide of higher toxicity can be increased by the presence of other chemicals in a mixture (Woods *et al.* 2002). This can help explain the greater than additive toxicity noted for combinations of organophosphorus insecticides and other pesticides.

Inhibition of enzymes that are responsible for detoxification will result in increased levels of active pesticide to interact with target sites (Woods *et al.* 2002). Carboxylesterases are an important class of serine hydrolases that cleave esters into the corresponding alcohol and acid. They can serve an important function by detoxifying pyrethroids and other ester containing pesticides such as herbicides (Denton *et al.* 2002). However, carboxylesterases can be inhibited by organophosphates and carbamates. Mixtures of organophosphates and pyrethroids could potentially exhibit a synergistic toxicity. Denton *et al.* (2002) examined joint mixture toxicity of diazinon and esfenvalerate to fathead minnows. The observed greater than additive (synergistic) toxicity was attributed to inhibition of carboxylesterase activity by diazinon, a potent organophosphate.

Sprague Mixture Analysis. The concept of concentration addition has been used to quantitatively analyze the effect of simultaneous exposure of pesticides to salmonids from pesticide application at Sprague. Additive action is the most common form of mixture toxicity (Marking 1985), and would be very relevant considering the type of pesticides used at Sprague. Greater than additive or less than additive interactions would be exceptions and are difficult to predict.

Concentration addition is expressed mathematically as: $$\sum_{i\text{-}1}^{n} \frac{C_i}{ECx_i} = 1$$

For a multi-component mixture of n substances: c_i is the concentration of the individual substances present in a mixture or dose, ECx_i is the equivalent effect concentrations of the individual substance. The equivalent effect concentrations must be similar in the respect of the assessment endpoint for this approach to hold scientific relevance. The quotients resulting from c_i/ECx_i would then represent the concentrations of individual mixture components as fractions of equitoxic concentrations scaled for its relative potency, TU (toxic unit). By summing the toxic units, the toxic strength of a mixture of pesticides may be determined.

For example, assume a chemical mixture of pesticide A and B with similar modes of toxic action occurs. The known environmental concentration or dose of A, is divided by the toxicity of A (LC50 or other relevant endpoint), which will result in a unitless fractional toxic unit for A. The same procedure is followed for each component in the mixture. The summation of toxic units A and B carries a result that approaches 1. If 1 is reached, then it can be assumed that there is additive toxicity on the acute level.[13]

Concentration addition implies that every toxicant in any concentration contributes, more or less, to the overall toxicity of a mixture, and holds the assumption that the chemicals in a mixture exhibit a similar mode of action. There are two major pesticide groups proposed for use in Sprague that fulfill these requirements. The organophosphate insecticide group: Acephate, diazinon, chlorpyrifos, and dimethoate, all act similarly in the inhibition of acetylcholinesterase, and the pyrethroid insecticide group: Esfenvalerate and permethrin, which act similarly in the blocking of neural voltage activated sodium/calcium channels. For the purpose of this analysis it is assumed that these groups of pesticides would be simultaneously present in salmonid habitat at modeled concentrations from erosion, runoff, and drift.[14] Traditionally, each pesticide group would undergo a separate analysis. In the BLM's BA, these pesticides were analyzed individually without consideration to the overall toxicity of a mixture.

Within this analysis, the toxic unit approach described above was used to assess the groups of similarly acting pesticides (organophosphates and pyrethroids) in a specific waterbody using the maximum BLM modeled concentrations due to drift, runoff, and erosion. For instance, as seen in Table 2, esfenvalerate is proposed to be applied within the May through July period annually,

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[13] Acute mortality data (LC50s) were used as the equivalent effect concentrations of the individual substances. Sublethal or LOEC data can also be used if available.

[14] The highest concentrations in these streams were identified (Table 8-1 in the BA), and can be considered to represent 24-hour average concentrations.

using high-pressure hydraulic sprayer, a hydraulic sprayer with hand-held wand and/or a backpack sprayer.

The BLM-modeled estimates of water concentrations from each application type from drift and runoff were then summed. This summation is not unrealistic because during most of the application window precipitation levels are low relative to other periods, and generally continue to decrease per month, thus reducing the likelihood of runoff delivery facilitated by individual rain events, and individual applications. As such, most delivery to the drainages of Sprague of esfenvalerate applied from April through July could occur in zone three (September through December) when precipitation increases and overland flow is more likely. Summation of these individual model results is logical and represents a hypothesis of plausible exposure concentrations to SONC coho salmon within the listed waterways.[15]

The equivalent effect concentrations of the individual substances were taken from the scientific literature pertaining to the assessment endpoint in question. As depicted in Table 9, after a toxic unit was calculated for each model concentration, they were summed up to give a final toxic unit. As mentioned before, as the final toxic unit approaches one, we can expect acute effects.

Table 9. Mixture Toxicity for Fish Species Within Receiving Waterways

Chemical	App Method	Jump-off Joe Creek (mg/L)
Organophosphate group		
Acephate	HPHS runoff&erosion	0
Chlorpyrifos	HPHS & HHW runoff & erosion	2.99e-06
Diazinon	HPHS & HHW runoff & erosion	1.39e-08
Dimethoate	HPHS runoff&erosion	0
	TU summation	**3.00e-06**
Pyrethroid group		
Esfenvalerate	HPHS runoff&erosion	2.63e-05
	HHW&BP runoff&erosion	1.41e-05*
Permethrin	HPHS runoff&erosion	1.54e-07
	HHW&BP runoff&erosion	2.30e-08
	TU summation	**1.41e-05**

* Permethrin and Esfenvalerate will not be used in the same year, and only one application method would be used in a year. Note that in this case, only the value for Esfenvalerate HHW&BP, is summed, reflecting the worst case scenario within the proposed action.

** Numerical values are in scientific notation.

[15] Note that chemical degradation, or binding to soils, may dilute concentrations or delay delivery to surface waters.

Referring to Table 9, the final toxic units for organophosphates and pyrethroids within Jump-off Joe Creek are extremely low, several orders of magnitude below where we expect there to be an acute effect to fish species. However as recognized in the environmental baseline, additional pesticides outside of this analysis are likely to increase the mixture toxicity reported in this table.

Table 10. Mixture Toxicity for Macroinvertebrates Within Receiving Waterways

Chemical	App Method	Jump-off Joe Creek (mg/L)
Organophosphate group		
Acephate	HPHS runoff&erosion	0
Chlorpyrifos	HPHS & HHW runoff & erosion	8.96e-05
Diazinon	HPHS & HHW runoff & erosion	1.51e-06
Dimethoate	HPHS runoff&erosion	0
	TU summation	**9.11e-05**
Pyrethroid group		
Esfenvalerate	HPHS runoff&erosion	7.70e-05
	HHW&BP runoff&erosion	4.13e-05*
Permethrin	HPHS runoff&erosion	1.15e-06
	HHW&BP runoff&erosion	1.71e-07
	TU summation	**4.13e-05**

* Permethrin and Esfenvalerate will not be used in the same year, and only one application method would be used in a year. Note that in this case, only the value for Esfenvalerate HHW&BP, is summed, reflecting the worst case scenario within the proposed action.

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** Numerical values are in scientific notation.

Macroinvertebrates are generally more sensitive to pesticides than salmonids. We would expect to see similar toxic effects as before but magnified. Referring to Table 10, the final toxic units for organophosphates and pyrethroids within Jump-off Joe Creek are extremely low, several orders of magnitude below where we expect there to be any acute effects to macroinvertebrates. However as recognized in the environmental baseline discussion, there is potential for additional pesticides outside of this analysis to increase the mixture toxicity reported in this table.

Prey Base Effects and Bioaccumulation. It is becoming increasingly evident that the indirect effects of contaminants on ecosystem structure and function are a key factor in determining a toxicant's cumulative risk to aquatic organisms (Preston, 2002). As mentioned within the analysis of the family of pesticide above (as applicable), adverse effect to salmonid prey base can occur from exposure to some substances. Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the acutely toxic effects of herbicides. Therefore, chemicals can potentially impact the structure of aquatic communities at

concentrations that fall below the threshold for direct biological impairment in salmon. The integrity of the aquatic food chain is an essential biological requirement for salmon and steelhead, and the reasonable likelihood herbicide applications will reduce the productivity of streams and rivers is a significant adverse effect.

Pesticide, herbicide, and fertilizer effects to salmonid prey base typically occur through two primary mechanisms; effects to the amount and/or type of food supply, or by pesticide exposure via food organisms. Depending on the exposure scenario, effects to aquatic invertebrate communities can be very short-term, or take months or years to fully recover. Pesticide exposure via food organisms is likely to be much more episodic and short-term. Norris *et al.* (1991) provide a summary and literature review of pesticide and fertilizer effects to salmonids. The amount and/or type of food supply can be altered by pesticides and fertilizers in complex and subtle ways, particularly if the aquatic system is exposed to a combination of insecticides, herbicides, and fertilizers.

Insecticides can alter the prey base by direct mortality of aquatic invertebrates. Insecticides are typically more toxic to fish and other aquatic organisms than herbicides, but are generally applied at lower rates (Beschta *et al.* 1995). Insecticides can cause direct mortality of aquatic invertebrates, or trigger extensive drift of aquatic invertebrates out of the affected area (Spence *et al.* 1996). If grazing invertebrates are reduced or eliminated from a stream reach, primary production release may occur (such as algal blooms), altering trophic structure.

Herbicides are often not highly toxic to salmonids, as they are generally designed to interfere with physiological systems unique to plants. However, low concentrations of herbicides may exert significant effects on salmonid prey items by affecting algal or aquatic plant communities (Pratt *et al.* 1997), or directly on salmonids through sublethal effects of the herbicide (Spence *et al.* 1996). In addition, some herbicides are moderate to highly toxic to aquatic invertebrates, such as triclopyr ester (SERA 2003b), and adjuvants and surfactants present in herbicide commercial formulations can greatly enhance toxicity (Stark and Walthall 2003; SERA 1997). Fertilizers can also affect salmonid food supply by increasing algal and other aquatic plant growth, altering the aquatic invertebrate community.

Salmonid pesticide exposure through food organisms can occur through incidental exposure of terrestrial insects which subsequently become prey items for fish (Norris *et al.* 1991), or indirectly through invertebrate ingestion of organic material delivered to the aquatic system (Urban and Cook, 1986). Pesticides which are more lipophilic (fat soluble) will tend to partition into organic material in or on soil. Runoff can mobilize organic material into streams where it is consumed by insects and crustaceans. Little data is available on the risk of exposure via this pathway, but risk is likely to be highly variable depending on conditions at the time of application, such as seasonal timing.

Bioaccumulation in fish is partially mediated by the presence of insecticides and herbicides in food items and sediment residues, but also includes bioconcentration, defined as passive uptake from the water column (Klaassen, *et al.* 1986). The lipophilicity of the pesticide and fat content

of the organism are the primary factors determining the extent of bioaccumulation. Pesticides with high lipophilicity tend to partition out of the water column and into food items, with the degree of partitioning proportional to the organism fat content. Concentration up the food chain (biomagnification) occurs when repeated exposure through consumption of contaminated prey items results in high concentrations of pesticide in predators, such as salmonids. In order for bioaccumulation to occur, a pesticide must have sufficient lipophilicity and persistence, and relatively low acute toxicity. Within the BA, the potential for bioaccumulation of degradates and metabolites is not addressed.

There is a considerable amount of mining in the Jump-off Joe Creek Watershed, particularly in the upper and middle reaches of Jump-off Joe and Louse Creeks (BLM 1998). This can contribute to stream sediment and turbidity which could potentially exacerbate pyrethroid toxicity. Furthermore, benthic macroinvertebrates that ingest sediment while consuming detritus will be exposed to concentrations of pyrethroids much higher than in the water column. The greatest effect of insecticides on fish probably arises from effects on terrestrial and aquatic insects that form salmonid food base (Spence *et al.* 1996). Pyrethroid insecticides readily bind to organic matter in the soil, have little mobility, and are practically insoluble in water. Water containing a high amount of suspended sediment will increase the bioavailability of pyrethroids to aquatic organisms. When caged rainbow trout were exposed to cypermethrin in a pond containing 14 to 22 mg/L suspended solids, the amount of pesticide necessary to result in mortality increased by nearly five times (from 0.001 to 0.005 mg/L) (Shires 1983).

The possibility of adverse effects from additive, antagonistic or synergistic effects from multiple applications exist. The relative risk of these type of adverse effects depends upon the volume and timing of their delivery, and background water quality conditions. Within the zones of possible exposure periods described above, the greatest likelihood of additive/synergistic effects from applications would occur anytime precipitation events cause significant subsurface or overland flow delivery to aquatic systems. The volume and types of pesticides delivered would depend upon the relative success of CPs to inhibit off-target delivery. At Sprague, it is thought that the greatest potential for this pathway of adverse effects would occur in zone two (May through September) and zone three (October though December). As precipitation levels rise, subsurface and overland flow off Sprague will increase, thus pesticide delivery to Jump-off Joe Creek and the Rogue River is reasonably likely to occur. As previously mentioned, model results are derived from a number of conservative assumptions, and NMFS utilized the maximum application rate scenario, and the application frequency listed in Table 8.

Cultural, Biological, and Physical Methods. The cultural, biological, and physical pest treatments are unlikely to have measurable effects, due to the small amount of area where these treatments would be applied, and the very limited amount of disturbance to riparian soils and native vegetation communities the treatments are expected to create. Cultural and biological controls have very little potential to effect salmonids or their habitat. Cultural controls are preventive measures to reduce the risk of introduction or dissemination of weeds. They do not involve ground disturbing activities. Biological controls use insects and pathogens determined to be host-specific, highly damaging to targeted species, able to survive in the host's habitat, free

of natural parasites, and not likely to be parasitized in the host plant's habitat. Biological controls pose no foreseeable risk to salmonids or their habitat. Physical controls involve ground disturbing activities (pulling or cutting of weeds). However, the scope and magnitude of this action is so limited that any effect to salmonids or their habitat is considered negligible. The use of prescribed burns is limited to non-riparian areas. Provided that proper treatment methods (*i.e.*, burn containment and timing) are used, there would be very little potential for adverse effects.

Establishment of Monitoring Criteria. The following pesticides proposed for use at Sprague (Table 11) posed the largest threat to aquatic organisms and habitat. The close monitoring of these contaminants is necessary in order monitor the effectiveness of CPs and the Terms and Conditions of this Opinion.

Low and high triggers for reinitiation were established by considering LC50 values taken from the scientific literature, and dividing by 20 to create a 'low trigger,' and by 2 to create a 'high trigger.'

The low trigger reflects a conservation measure that attempts to reduce, though not avoid, sublethal effects in coho salmon. A high trigger reflects a concentration in which direct mortalities may occur which is not authorized in this Opinion. The low trigger levels are those estimated dissolved contaminant concentrations in water, which can be surpassed a single time, for one compound, during each of the three annual precipitation and application zones as displayed within the Opinion (Figure 2 and Table 6). Thus, a total of three annual exceedances of the low trigger are allowed per year, one during each period.

A high trigger reflects a concentration in which direct mortalities may occur which is not authorized in this Opinion. The high trigger values are those dissolved contaminant concentrations in flowing water at which acute lethality may occur. Meeting or exceeding these concentrations would require re-initiation of consultation.

The literature sources were agreed upon by NOAA and BLM and previously used by the BLM in an extensive effects analysis section of the BA. Detection limits of pesticides are also given if known. The low trigger and high trigger values may be revisited (and potentially revised) annually to incorporate new data regarding baseline conditions, and newly-published sublethal effects.

Table 11. Monitoring Triggers

Compound	Chemical Family	LC50 (PPB)	'low trigger'	'high trigger'	Detection Limit	LC50 Source
Chlorpyrifos	Organo-phosphate	3	0.15	1.5	0.04	EPA 1984
Dimethoate		6200	310	3100	0.8	EPA 1999
Diazinon		90	4.5	45	0.2	Johnson & Finley 1980
Permethrin	Pyrethroids	7	0.4	3.5	0.4	Holcombe *et al.* 1982
Esfenvalerate		0.09	0.0005	0.045	0.02	Curtis *et al.*, 1985
Propargite	Organo-sulfite	118	5.9	59	0.4	EPA 2000
Trichloropyridnol (Triclopyr and chlorpyrifos degradate) picloram[16]	Pyridine derivatives	1500	75	750	NA	Wan 1988
Chlorothanil	Chlorinated-benzene nitrile	42	2.1	21	0.04	EPA 1999

Semi-Permeable Membrane Devices (SPMDs). SPMDs shall be deployed to monitor instream waterborne concentrations of pesticide contaminats. The SPMD is an instream 'accumulator' which allows calculation of an average chemical concentration during the period of deployment.

SPMDs provide a time-weighted average concentration for the chemicals of interest and only measure the dissolved and, therefore, the readily bioavailable fraction. The contaminants of highest concern (pyrethroids and organophosphates) are highly hydrophobic and exhibit high Koc-binding affinities. These contaminants are likely to bind to available particulate organic carbon and ultimately move as particles in marine, freshwater, and estuarine ecosystems. Thus, the SPMD data will capture only a small fraction of these contaminants that actually enters the waterbody. Contaminants sequestered by particulate organic carbon are not sampled and are still available to enter food webs, or play significant roles in habitat forming processes. However, SPMDs successfully monitor the dissolved waterborne concentrations of contaminants that are

[16] Trichloropyridnol (TCP) is a degradate of both chlorpyrifos and Triclopyr, that is classified as moderately toxic to fish. As a moderately toxic, common degradate of two of the pesticides applied, with a half-life ranging from 12 - 229 days, TCP poses a risk to ESA-listed salmonids greater than or equal to some of the pesticides applied. Therefore, TCP was added to the list of compounds to be monitored.

immediately bioavailable to ESA-listed species. Thus, they are a reliable source of information on the effectiveness of conservation practices to reduce exposure and eliminate any chance of acute mortalities.

Critical Habitat Effects. SONC coho salmon critical habitat was designated May 5, 1999 (64 FR 24049). SONC coho salmon critical habitat encompasses accessible reaches of all rivers, including estuarine areas and tributaries, between the Mattole River in California, and the Elk River in Oregon, including all waterways and substrate below longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for at least several hundred years).

The critical habitat designation focused on essential habitat features which included spawning sites, food resources, water quality, water quantity, and riparian vegetation. The proposed IPM has the potential to affect food resources and water quality.

NMFS expects short term and sporadic degradation of water quality from pesticide drift soon after some individual applications. Because these short term and sporadic degradations are anticipated to occur infrequently, habitat related changes from drift of pesticides are not expected to occur - riparian and aquatic vegetation quantity and diversity loss are unlikely. Food sources, such as aquatic invertebrates, are generally more sensitive to chemical habitat alteration than fish. Water quality degradation from drift may result in isolated and temporal losses of benthic production.

Surface water runoff delivery of pesticides, expected to sporadically occur in relation to seasonal rises in precipitation, may deliver pesticides to surface waters for longer periods. This delivery, while possibly at lower concentrations than drift, may result in greater loss of aquatic plant and benthic production, depending upon the duration and concentration of exposure.

Finally, if pesticide use is effective at controlling targeted pest, it is possible that aquatic food sources could be diminished in areas occupied by SONC coho salmon. At least some of the targeted insects (and non-targeted insects as well) would be expected to enter the aquatic food chain within some period of their life-cycle. This entry to the aquatic food chain, either randomly or through a necessary life-stage, would represent possible prey. Food loss within critical habitat could reduce its conservation value. In addition, some insects exposed to chemicals could nonetheless enter the food chain within critical habitat. These insects would represent reduced, and likely harmful, food sources.

The combination of alternative pest management methods that pose no risk to critical habitat (*i.e.* biological controls such as bat boxes), and proper implementation of application setbacks from surface water, CPs, and proper timing of application within least-risk weather periods (*i.e.* minimal wind and change of rain) are expected to preclude multiple and relatively large volume non-target delivery of pesticides to surface water. Sprague's one mile distance from critical habitat is expected to further attenuate the potential for degradation of food sources and water quality. Finally, the monitoring and adaptive management regime will gauge the relative effectiveness of these measures, preclude chronic water quality degradation, and facilitate

changes in BLM operations to enhance protective measures in light of new information. Such new information could include new literature on sublethal effects to fish and their prey base, baseline conditions within the receiving waterways, and drift card and water sampling data in conjunction with certain applications, among other data. Consequently, NMFS does not expect that the net effect of these actions will diminish the conservation value of designated critical habitat for recovery of SONC coho salmon.

Cumulative Effects

Cumulative effects are defined in 50 C.F.R. 402.02 as "those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." Other activities within the watershed have the potential to impact fish and habitat within the action area. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and certain land management activities are being (or have been) reviewed through separate section 7 consultation processes with a variety of Federal action agencies.

Within this Opinion, cumulative effects have been analyzed from the context of future pesticide use and pollutant discharges (and other water quality degradation) to surface waters from non-Federal land use. Such land uses include urban and suburban, commercial forestry and agriculture.

While general land use is known, details of pesticide and fertilizer application amounts and acres treated are not well documented for the Jump-off Joe Creek Watershed upstream and downstream from the project area. However, pesticide application rates for various crops grown in the Rogue River Basin have been documented (Jenkins 1999), as displayed in Table 12.

Table 12. Rogue River Agriculture and Associated Pesticides

CROP:	**Alfalfa**	**Apples**	**Barley**	**Corn, silage**	**Corn, sweet**	**Grapes**	**Oats**	**Pears**	**Squash, pumpkin**	**Tomato, Bell Pepper, Eggplant**	**Wheat**	
Planted Acres:	**9,200**	**638**	**1,328**	**550**	**128**	**500**	**178**	**7,100**	**35**	**99**	**2,081**	**total: 21,837**
Pesticide (lbs. a.i.):												
2,4-D				20				500			20	
2,4-DB	100											
ABAMECTIN								485				
ALACHLOR				20	20							
AMITRAZ								6,118				
ATRAZINE				10	10							
AZINPHOS-METHYL		3,000						30,000				
B. T.										15		
BENOMYL											25	
BENTAZON				38								

CROP:	**Alfalfa**	**Apples**	**Barley**	**Corn, silage**	**Corn, sweet**	**Grapes**	**Oats**	**Pears**	**Squash, pumpkin**	**Tomato, Bell Pepper, Eggplant**	**Wheat**	
Planted Acres:	**9,200**	**638**	**1,328**	**550**	**128**	**500**	**178**	**7,100**	**35**	**99**	**2,081**	**total: 21,837**
Pesticide (lbs. a.i.):												
BROMOXYNIL	60		123				16				284	
CAPTAN				10	10							
CARBARYL	20	19				20						
CARBOFURAN						29						
CARBOXIN			36								56	
CHLORAMBEN									26			
CHLORPYRIFOS		100		55	37			600				
CHLORPYRIFOS-METHYL											56	
CLOFENTEZINE								125				
COPPER								30,000		10		
DIAZINON								971				
DICAMBA			84				12				133	
DICLOFOP			574								896	
DIFENZOQUAT											103	
DIMETHOATE											24	
DIURON	100	125	15			50		8,000			1,472	
DODINE								35,000				
ENDOSULFAN								2,000				
EPTC	100			50								
ESFENVALERATE					10			600				
ETHALFLURALIN									32			
ETHEPHON											10	
ETHOPROP				55	43							
FENARIMOL		51						245				
FENBUTATIN-OXIDE								1,664				
FONOFOS				122	53							
FORMETANATE HYDROCHLORIDE								500				
GLYPHOSATE	138			28		219		976	22	30	16	
HEXAZINONE	644											
IPRODIONE						300						
LIME SULFUR		81						60,000				
MALATHION						51						
MANCOZEB								20,000			33	
MANEB										162		
MCPA			653				120				1,106	
METALAXYL				10	10					27		
METOLACHLOR				139	74			39				
METRIBUZIN	1,380		141								227	

CROP:	**Alfalfa**	**Apples**	**Barley**	**Corn, silage**	**Corn, sweet**	**Grapes**	**Oats**	**Pears**	**Squash, pumpkin**	**Tomato, Bell Pepper, Eggplant**	**Wheat**	
Planted Acres:	**9,200**	**638**	**1,328**	**550**	**128**	**500**	**178**	**7,100**	**35**	**99**	**2,081**	**total: 21,837**
Pesticide (lbs. a.i.):												
MYCLOBUTANIL		81										
NAA								414				
NAPROPAMIDE						37						
NICOSULFURON				10								
NORFLURAZON								59				
OIL		6,960						65,000				
ORYZALIN		132				10		1,730				
OXYTHIOQUINOX								70				
PARAQUAT	100			12		54		400				
PHORATE											41	
PHOSMET		435						18,000				
PRONAMIDE	644											
PROPARGITE				11								
PROPICONAZOLE											50	
SETHOXYDIM	276											
SIMAZINE		169				221		2,958				
STREPTOMYCIN				10	10			8,000				
SULFUR	207					2,797						
THIFENSULFURON											10	
THIOBENDAZOLE								10				
THIRAM			36	10	10						56	
TRIADIMEFON						15		200			16	
TRIADIMENOL											15	
TRIALLATE											864	
TRIBENURON											13	
TRIFLURALIN											95	
VERNOLATE					12							
ZIRAM								15,000				
Total Pesticide (lbs. a.i.)	**3,769**	**11,153**	**1,662**	**610**	**299**	**3,803**	**148**	**309,664**	**80**	**244**	**5,621**	**337,053**

There is a logical deduction that the various other types of agricultural land uses incorporate pesticides into their land management although the timing, quantities and frequency of applications are unknown at this time. As noted in the Sprague (draft) EIS, the Rogue River receives return flow from irrigated agriculture and other land use practices. Return irrigation flows are likely to provide more efficient delivery of pesticides and nutrients than typical subsurface runoff.

From the above discussion, it is evident that some level of pesticides and adjuvants are likely to be present in Jump-off Joe Creek. The number of pesticides present most likely increases in the downstream direction, as runoff from cumulative agricultural (and other) land use increases. In addition, the Rogue River, to which Jump-off Joe Creek is a tributary, has considerable agricultural land use, with associated pesticide application, within the watershed. Given the known water quality stressors (high summer water temperatures and low dissolved oxygen) facing rearing juvenile coho salmon in Jump-off Joe Creek, and the very likely, but unquantified, presence of pesticides from upstream applications, any additional exposure to toxic substances is very likely to adversely affect fish rearing within the area influenced by the proposed project.

Confounding this assessment are the above described sources of uncertainty, particularly the future non-BLM discharges of various pesticides, herbicides and fertilizers. Background concentrations of pesticides from non-BLM applications are reasonably certain to persist over time. However, the recent U.S. District Court for the Western District of Washington decision that require buffers for certain pesticides and streams could reduce the volumes and types of cumulative (non-BLM) discharges that occur in the action area, though the degree of improvement would be difficult to determine.

NMFS believes that baseline conditions within much of the action area will be subject to local changes in the short and long term. NMFS assumes that future private and state actions will continue at similar intensities as in recent years.

Conclusion

After reviewing the best available scientific and commercial information regarding the biological requirements and the status of the SONC coho salmon ESU considered in this Opinion, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify designated critical habitat.

These conclusions are based on the following considerations: (1) The BLM will use IPM to ensure that a combination of all available pest control strategies, including pesticide alternatives, are applied to keep pests below treatment thresholds while reducing the need for pesticide applications; (2) when chemical use is required, BLM will select the pesticide formula that is least toxic for fish and aquatic life while achieving management needs; (3) the application of chemicals will be timed to coincide with weather conditions that are least likely to result in riparian and aquatic contamination; (4) broad non-spray buffers will be observed to reduce the likelihood of significant quantities of pesticide will be transported to riparian and aquatic systems through drift, surface runoff, and groundwater runoff; (5) chemicals will be applied using precise methods designed to reduce the amount of pesticide loss; (6) a comprehensive sampling, monitoring, and analysis protocol will be used to ensure that the behavior and transport of chemicals in the environment are as predicted; (7) the proposed action includes an explicit process to quickly modify the proposed action based on any significant new information

that may be developed through consultations now underway with the EPA regarding the effects of pesticides proposed for use during management of the Sprague seed orchard; and (8) all fertilizer applications will be applied at environmentally optimum rates designed to reduce the presence of fertilizer products in drainage water delivered to surface and groundwater systems

Conservation Recommendations

Section 7 (a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of habitats, or to develop additional information. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be carried out by the BLM. Information from the proposed recommendations will help to reduce uncertainty about the effects of past and ongoing human and natural factors leading to the status of ESA-listed salmon, their habitats, and the aquatic ecosystem within the action area.

1. The BLM should conduct or fund additional monitoring of the Jump Off Joe Creek Watershed for toxic pesticides, including sediment sampling. Certain classes of pesticides and herbicides within the proposed action exhibit an affinity for binding to organic carbon molecules and are readily taken up in the sediments. Particulate-bound contaminants can still be available to enter freshwater food webs and provide a different exposure pathway for salmonids. The sediment sampling should occur within receiving waterways and near sources of known discharges. This data would assist in future ESA analysis for similar proposed IPM actions, and provide meaningful data for adaptive management of the proposed IPM.
2. The BLM should conduct or fund a study of non-pesticide-use IPM methods relative to pesticide-use effectiveness. The study should be tailored to determine the various production implications of these two approaches.

To be kept informed of actions minimizing or avoiding adverse effects, or those that benefit ESA-listed salmon and steelhead or their habitats, NMFS requests notification of the achievement of any conservation recommendations.

Reinitiation of Consultation

Consultation must be reinitiated if: (1) The amount or extent of taking specified in the incidental take statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 C.F.R. 402.16).

Monitoring data showing that pesticide residues exceed thresholds within the terms and conditions of this Opinion, are an example of new information that would require reinitiation.

If the BLM fails to provide specified monitoring information by November 15 of each year (excluding 2004), NMFS will consider that a modification of the action that causes an effect on listed species not previously considered and causes the incidental take statement of the Opinion to expire. Consultation also must be reinitiated five years after the date this Opinion is signed. To reinitiate consultation, contact the Oregon State Habitat Office of the Habitat Conservation Division of NMFS, and refer to NMFS No.: 2004/00206.

Incidental Take Statement

Section 9(a)(1) and protective regulations adopted pursuant to section 4(d) of the ESA prohibit the taking of listed species without a specific permit or exemption. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

Amount or Extent of the Take

Individuals of SONC coho salmon will be present in the action area during part of the year when actions necessary to carry out the Sprague Seed Orchard IPM are likely to release pesticides that will travel into streams and rivers occupied by ESA-listed species and their prey. As discussed in the biological opinion, pesticides released into those streams are reasonably likely to injure or kill some juvenile salmonids and their prey through a combination lethal and sublethal effects that will continue while the Sprague Seed Orchard IPM is in effect and pesticide use is part of that program.

Because such pesticide releases are likely to injure or kill individuals of these ESA-listed species, incidental take is reasonably certain to occur. However, the relationship between habitat conditions and the distribution and abundance of salmonids in the action area is imprecise, as is the exact type, amount and timing of the pesticides that are likely to be released, such that a specific number of individuals likely to be taken cannot be practically obtained. In these circumstances, NMFS uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take as a numerical level of habitat disturbance.

In this case, the extent of take for this incidental take statement is limited to that which will result from detection of any pesticide concentration in the water column shown by the 'low trigger' and 'high trigger' values presented in Table 13, below. These indicators and their

estimated values were selected using the best available scientific information on the effects of acute toxicity on ESA-listed salmon.

The 'low trigger' values refer to concentrations in flowing water that may be exceeded for one compound, one time, during each of the three annual precipitation and application 'zones' as described in the biological opinion. Thus, a total of three annual exceedences of the 'low triggers' are allowed, one during each period. The 'high trigger' values are concentrations at which acute lethal take is likely to occur and are the maximum extent of take authorized by this opinion. Any observed concentration of a compound named here that is greater than a 'high trigger' will exceed the extent of take authorized by this opinion. These 'low trigger' and 'high trigger' values may be revisited annually to incorporate any significant new information regarding baseline conditions and the lethal or sublethal effects of pesticides on salmonids.

Table 13. Extent of incidental take anticipated to result from completion of the Sprague Seed Orchard IPM quantified as pesticide concentrations in the water column.

Compound	Chemical Family	Low Trigger (PPB)	High Trigger (PPB)
Chlorpyrifos	Organo-phosphate	0.15	1.5
Dimethoate		310	3100
Diazinon		4.5	45
Permethrin	Pyrethroids	0.4	3.5
Esfenvalerate		0.0005	0.045
Propargite	Organo-sulfite	5.9	59
Trichloropyridnol (Triclopyr and chlorpyrifos degradate) picloram	Pyridine derivatives	75	750
Chlorothanil	Chlorinated-benzene nitrile	2.1	21

In this Opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species. Moreover, the habitat that will be affected is not unique and does not appear to be limited on a watershed scale or site-specific basis. The extent of habitat affected by the action is the threshold for reinitiating consultation. Should any of these limits be exceeded during project activities, the reinitiation provisions of this Opinion apply.

Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The BLM has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the BLM fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions.

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of listed species resulting from completion of the proposed action.

The BLM Shall:

1. Minimize incidental take by ensuring that orchard pests are managed using IPM techniques that use treatment thresholds and minimize the need for pesticide application.
2. Minimize incidental take from pesticide applications by choosing pesticide formulas, timing, place, and manner of pesticide use to minimize the likelihood of delivery to riparian and aquatic systems.
3. Minimize incidental take from fertilizer application by ensuring that fertilizer is applied in a time, place and manner that minimizes the likelihood of delivery to surface and groundwater.
4. Ensure completion of an annual comprehensive monitoring and operations reporting program to confirm this Opinion is meeting its objective of minimizing take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BLM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary and, in relevant part, apply equally to proposed actions in all categories of activity.

1. To implement Reasonable and Prudent Measure #1 (integrated pest management) the BLM shall:

   a. Treatment Thresholds. Ensure that no action to suppress insect pests will be taken unless pest monitoring show that one or more pests have reached a threshold at which losses in seed yield and quality exceed the economic and environmental cost of treatment. No pesticide will be applied on a routine basis, without regard for treatment thresholds based on pest populations.

b. Prescribed Burning. When prescribed burning will be used as a pest control, the following conditions will apply.

i. Design the prescribed burn to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function.

ii. Ensure that all vehicles, including emergency equipment, are not operated, maintained and stored next to any stream, waterbody or wetland. Equipment shall not disturb native riparian vegetation.

iii. Ensure that all vehicles, including emergency equipment, are not fueled within 150 feet of any waterbody.

iv. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to restore riparian ground cover and vegetation.

v. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.

c. Each supervisor engaged in IPM activities must be informed of the following requirement:

NOTICE: If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NMFS Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

2. To implement Reasonable and Prudent Measure #2 (use of pesticides), the BLM shall ensure that:

a. Spill Prevention Plan and Methods. Prepare and carry out a spill prevention plan to prevent contamination from spill of pesticides and other hazardous materials. The plan will contain the pertinent elements listed below, meet requirements of all applicable laws and regulations, and must be available for inspection on request by NMFS.

i. The name and address of the party(s) responsible for accomplishment of the spill prevention plan.

ii. A description of any regulated pesticide and other hazardous materials that will be used as part of the IPM Plan.

iii. Training and certification for those who will be involved with pesticide transportation, storage, use, disposal, record keeping, monitoring, and emergency response.

iv. Practices to prevent spills associated with mixing sites (*i.e.*, containment), critical areas where spills are likely to occur, and environmental restrictions.

v. Spill containment and notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available onsite, proposed methods for disposal of spilled materials.

b. Timing of Pesticide Application. Time pesticide applications as follows.

i. Prioritize applications for mornings or evenings when pollinators are not active (as seasonally applicable) in accordance with the best overall weather period.

ii. Weather. Pesticides will **not** be applied under the following weather and soil conditions unless the product label specifically recommends otherwise.

(1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. These methods shall be documented and included in the annual monitoring report.

(2) In areas with standing water and saturated soils.

(3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.

(4) In wind that exceeds 6 miles per hour or blows toward flowing streams.

c. Areas of Pesticide Application.

i. Application Buffers. Application methods shall be restricted by zones as follows. Zone widths refer distances from any intermittent or perennial stream or waterbody with flowing water, measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration zone, or the edge of any associated wetland, whichever is greater. These buffer widths shall not be decreased over the five-year term of this Opinion.

(1) <20 Feet. Cultural methods, backpack, hand-held wick, injection using the Rodeo® formulation of glyphosate.

(2) >50 Feet. Capsule implantation, hand sprayer, and hydraulic sprayer with handheld wand.

(3) >90 Feet. All of the above, and tractor-pulled spray rig with boom and high-pressure hydraulic sprayer.

3. To implement Reasonable and Prudent Measure #3 (use of fertilizers), the BLM shall ensure that:

   a. Fertilizer will not be appliled within 50 feet of any stream, wetland or other waterbody.
   b. Fertilizer will be applied at agronomic rates.[17]
   c. Fertilizer loading (pertaining to application equipment) areas shall be at least 100 feet from perennial streams.

4. To implement Reasonable and Prudent Measure #4 (monitoring and reporting), the BLM shall ensure that:

   a. Annual monitoring report. All water quality monitoring information associated with application of the Sprague Seed Orchard IPM program shall be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' shall include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, shall be contained in an Annual Sprague Seed Orchard Monitoring Report. This report shall be available to the public and regulatory agencies on November 15 of each year and be on file at the Sprague seed orchard. This report shall include the following information:
      i. Project Identification.
         (1) BLM contact person.
         (2) Pesticide project manager.
         (3) Starting and ending dates for work completed.
      ii. IPM Documentation.
         (1) Description of how treatments were based on weather and pest monitoring.
         (2) A description of the biological and cultural pest controls used before pesticides were applied, or the reasons that biological and cultural controls were not used. Note that this provision is applicable to initial decisions to apply pesticides in response to pest population levels, not each individual application, and shall be documented within the annual monitoring report.
      iii. Pesticide Use History.
         (1) Type of chemical applied.
         (2) Date of application.

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[17] 'Agronomic rate' means a quantity and timing of total nutrient application that does not exceed the requirements of the crop production and harvest or grazing system, as opposed to a nutrient application rate based on production goals that are difficult to define and variable. Calculation of the agronomic rate takes into account the total nitrogen or phosphorus resources for plant nutrition, and any retention of phosphorus in the soil and losses of nitrogen through denitrification and ammonia volatilization.

(3) Buffers present.
(4) Method of pesticide application.
(5) Total area treated.
(6) Amount of pesticide applied.
(7) Precipitation for the three days preceding and following application.
(8) Wind direction and speed, relative humidity, air temperature at time of application.
(9) Location used for mixing and loading and notes regarding whether any leakage or spills occurred.

iv. Effectiveness Monitoring.

(1) Orchard units or treatment areas directly beside open water (within 100 feet) shall require drift cards be placed at a maximum of 100-foot intervals along the edge of Sprague's unit before the application (for high-pressure hydraulic sprayer applications).
(2) If open canopy occurs in the waterway buffer, drift cards shall be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Any applications shall cease if there is any indication that there is off-target delivery occurring.
(3) Immediately after the application, the cards shall be collected and reviewed to determine if a drift signature is present, the extent of the drift, and the potential for aquatic contamination. A copy of all the cards shall be kept on file at Sprague, along with a record of their location and all the compliance monitoring documentation.

v. Surface Water Monitoring to Detect Drift.

(1) For high-pressure hydraulic sprayer applications of chemicals, water samples shall be collected before and after spray application that include representative '15 minute' and '24-hour (composite)' post treatment water samples.
(2) Surface water samples are collected within the project area, also, where appropriate, collect water samples concurrently where flowing water enters the project area to facilitate a baseline/cumulative concentration analysis.

vi. Surface Runoff.

(1) Continuous flow recording stations shall be established in the intermittent stream on the west side of OU 53 if water is flowing in this drainage to collect water and water column sediment samples during runoff events with the intention of providing individual storm concentrations. If this site does not have enough water to be effective, the BLM shall investigate sites further down the drainage. SPMDs may be used to supplement flow-weighted concentration monitoring.

(2) The data from recording stations shall be interpreted to be representative of water quality conditions as a result of the effectiveness of implemented protection measures and limitations in the higher-risk seed production areas.

(3) All data shall be used in conjunction with continuous recorded climate data to evaluate the effectiveness of protection measures and limitations in minimizing introduction of pesticides and fertilizers to the aquatic system.

(4) Samples shall be analyzed at a state-certified laboratory at the lowest certified detection levels.

Surface Drift monitoring shall occur for the following compounds that are applied using the specific methodologies.

Application Method	**Compound**	**Surface Water Drift Monitoring**	**Sites for Surface Water Drift Sampling**	**Sites for SPMD Placement**
High pressure hydraulic sprayer	Esfenvalerate Chlorpyrifos Permethrin Diazinon Dimethoate Propargite Chlorothalonil	A representative stream[18] or streams will be sampled and tested for each application	OU West, 53 West, 42 East, 43 All, 44PP all	OU 53 West
Hydraulic sprayer w/ handheld wand	Esfenvalerate	Surface water sampling and testing for each application within 250 feet of surface water		
Backpack Sprayer - Hand-held wand	Esfenvalerate	Surface water sampling and testing for each application within 100 feet of surface water		

Note: For Orchard Unit numbers referenced above, see page76-78of the Sprague Biological Assessment.

vii. Cumulative Concentrations Runoff.

(1) Stormflow with the highest potential for chemical presence shall be sampled and, during these flow events, samples shall be composited according to the rise and fall of the hydrograph,

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[18] A representative stream is any stream beside a spray unit, downwind of a spray unit, or otherwise liekly to be affected if dirft outisde the treatment units occurs.

(2) SPMDs will be deployed, to monitor the accumulation of chemicals in waters containing aquatic species. SPMDs shall be used in the intermittent stream on the west side of OU 53 if water is flowing in this drainage to collect water and water column sediment samples during runoff events with the intention of providing individual storm concentrations. If this site does not have enough water to be effective, the BLM shall investigate sites further down the drainage.

(3) SPMDs shall be deployed before initial winter storms and spring storm periods after pesticide application.

(4) Stream flow gauges (USGS and BLM) shall be maintained to provide flow data for deriving concentrations (chemical loading) over the period of time the SPMD is deployed.

(5) Data from the SPMD concentrations shall be used to compare and validate the storm flow concentration monitored during the deployment period.

(6) SPMDs shall be strategically deployed in timeframes that are representive of potential exposure scenarios, such as runoff from significant rain events and or drift during application. SPMDs shall be deployed for approximately 30 days, though smaller time increments are encouraged because they are more sensitive to pulses of pesticides.

vii. Validation Monitoring. For select sites, monitoring shall be used to validate the water quality modeling predictions presented in the EIS and BA.

(1) Concentrations shall be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.

(2) If detectable concentrations are found, stream concentrations shall also be compared to model results using actual application information, field-specific data, and continuous climate record. These data shall provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.

(4) A collection chamber shall be installed where there is overland flow in OU53. During the first overland flow event following select chemical applications, this sites shall be visited, and a water sample taken from the collection chamber, these data shall be used

to assess the mobility of chemicals that have been used onsite within the past year.

(5) For select sites and once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.

viii. Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, shall be immediately evaluated to determine if water sampling is desirable and necessary. If the spill occurs in an area that is reasonably certain to deliver to surface waters, either immediately, or on the next precipitation event, sampling shall occur, as appropriate. Water samples shall be collected in a sufficient number and at surface water and groundwater locations that shall allow characterization of impacts and effective remediation methods. Depending on ODEQ Monitoring Hazardous Substances Remediation Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil.

ix. Groundwater Monitoring. The two irrigation and three irrigation/domestic wells and one proposed test well at Sprague shall be used for monitoring of groundwater contamination. The pesticides chosen shall vary according to the rates, persistence, and mobility of the pesticides applied during the period since the last sampling. These samples shall occur annually, and normally be collected in late summer and handled according to state-certified laboratory instructions.

(1) Groundwater monitoring wells associated with the greenhouse effluent field shall be monitored. Water quality sampling shall be conducted when risks are highest for irrigation water to potentially reach the local ground water table. If 'point in time' samples are found to have detectible levels of the pesticide, SPMDs shall also be deployed in selected wells to allow a more quantitative determination of concentration over time.

(2) Notification of Discharge. If a surface water discharge occurs, the BLM shall notify NMFS within 10 business days of detection. Notification shall include the type, location, and concentration of the discharge.

x. Circumstances that would trigger reinitiation:

(1) More than one discharge per zone, as defined in this Opinion, between the 'low trigger' and 'high trigger'; values (within any one year). Note that discharges below the low trigger value are not applicable to this total.

(2) A discharge within any one year above the 'high trigger' value.

(3) For compounds with a common mode of action (*i.e.* pyrethroids and organophosphates), if the sum total of the toxic units is >0.05 (equivalent to 1/20th of the standardized LC50s) it will be counted as a 'low trigger' exceedence. If the sum total of the toxic units is > 0.5 (equivalent to ½ of the standardized LC50s) it will be counted as a 'high trigger' exceedence. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column). The toxic units for each class, pyrethroids, and organophosphates, will be calculated as outlined within this Opinion. Only one 'low trigger' exceedence will be counted if there is a toxic unit 'low trigger' exceedence for a particular chemical family that contains a 'low trigger' exceedence of an individual compound within that same chemical family.

(4) To account for the synergistic action of pyrethroids and organophosphates, as described within this Opinion, an exceedence of a 'low trigger' of both a pyrethroid and an organophosphate (either individually or as a sum total of family toxic units) will be considered the equivalent of exceeding a high trigger. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column), and includes SPMD data.

(5) Upon any SPMD detection, the data shall be used to provide a 24-hour average waterborne contaminant concentration for the chemicals that were applied and can be sequestered. To reflect the margin of error within the SPMD methodology, a two-fold safety factor (Huckins 2004) shall be applied to the back calculated 24-hour average concentration (multiply the value by two). The corrected 24-hour concentration shall then be treated as a discharge within the final monitoring plan and the same circumstances apply for reinitiation.

(6) An annual review of SPMD data collection, data use, and sampling methodology may occur. In the event of a detection, factors leading to the resultant discharge concentration shall be reviewed.

c. Annual Operation Report. The Annual Operation Report will be submitted to NMFS by December 1st, and include the following information (NMFS will review the Annual Operation Report within 30 business days of its receipt, note that the annual operations plan for 2005 only needs to include data specified within number (5)):

i. The results of the previous year monitoring program. If a discharge occurred during the previous year, possible causes of the discharge shall be explored, as well as future mitigation steps to prevent like discharges in the future.

ii. A data review of the pesticides that are proposed for use, or may be used, at Sprague in the following year. The review shall include:

(1) New scientific data regarding non-target fish species effects or environmental fate.

(2) Changes to EPA-approved labels (ESA-approved and other).

(3) A review of legal findings relevant to the use of pesticides.

(4) A plan for proposed pesticide applications for the following year, including, to the extent possible, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored.[19]

(5) Any proposed changes to the IPM, including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those proposed; or other relevant information.

(6) The annual report shall be sent to:

Director, Oregon State Habitat Office
NMFS
Attn: 2004/00206
525 NE Oregon Street
Portland, OR 97232

d. Annual coordination. Meet with NMFS by March 31 each year, as necessary, to discuss the annual monitoring report and any action necessary to make the program more effective.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).
- NMFS must provide conservation recommendations for any Federal or state action that would adversely affect EFH (§305(b)(4)(A)).
- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the

[19] The draft monitoring plan shall include specific proposed sampling locations, frequencies, and methods in relation to the application plan.

impact of the activity on EFH. In the case of a response that is inconsistent with NMFS EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities; 'necessary 'means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (50 C.F.R. 600.10). 'Adverse effect' means any impact which reduces quality and/or quantity of EFH, and may include direct (*i.e.*, contamination or physical disruption), indirect (*i.e.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810).

EFH consultation with NMFS is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

Identification of EFH

The Pacific Fishery Management Council designated EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream from certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the *Pacific Coast Salmon Plan* (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

Proposed Actions

The proposed action and action area are detailed above in this Opinion. The action area includes habitats that have been designated as EFH for various life-history stages of Chinook and coho salmon.

Effects of Proposed Action

As described in detail above, the proposed action may result in short- and long-term adverse effects to habitat due to adverse alteration of water quality.

Conclusion

NMFS concludes that the proposed action may adversely affect designated EFH for Chinook and coho salmon.

EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. The terms and conditions outlined in this Opinion are generally applicable to designated EFH for Chinook and coho salmon and address these adverse effects with the exception of monitoring requirements (RPM 4). Consequently, NMFS adopts Terms and Conditions 1 through 3 as EFH conservation recommendations.

Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse affects that the activity has on EFH. In the response is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

Supplemental Consultation

The BLM must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 C.F.R. 600.920(k)).

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law106-554) ('Data Quality Act') specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: This ESA section 7 consultation on the proposed programmatic IPM program at the Charles A. Sprague Seed Orchard in Josephine County, Oregon concluded that the action will not jeopardize the continued existence of SONC coho salmon. Pursuant to the MSA, NMFS provided the BLM with conservation recommendations to conserve EFH.

The intended user of this consultation is the BLM. The American public will benefit from the consultation.

This consultation will be posted on the NMFS Northwest Region web site (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, "Security of Automated Information Resources," Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 C.F.R. 402.01 *et seq*., and the MSA implementing regulations regarding EFH,50 C.F.R. 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this biological conference opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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